Incremental Progress in Restoring Beneficial Uses at The Canadian Areas of Concern:

Program Overview and Site Specific Analyses

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L'Accord Canada-Ontario relatif à la qualité de l'eau dans les Grand Lacs

Incremental Progress in Restoring Beneficial Uses at The Canadian Areas of Concern: Program Overview and Site Specific Analyses

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FOREWORD

This report provides a brief history and the current status of the Canada/Ontario Great Lakes Remedial Action Plan (RAP) program. It describes the program and highlights the progress that has been achieved in developing and implementing actions to rehabilitate the Great Lakes since the inception of the RAP Program in 1987. The information was compiled by interviewing RAP participants from each of the Areas of Concern and represents a consensus among those interviewed. The authors gratefully acknowledge the willingness of all those contacted to be candid in their perspectives and for the wealth of information they provided. Their expert opinions were invaluable in attempting to measure progress towards restoration of environmental quality and identifying future challenges to restore and protect the Great Lakes Basin. The conclusions are those of the authors.

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INTRODUCTION:

Since the inception of Remedial Action Plans (RAP) in 1987, the RAP communities and all levels of government have made substantial gains in restoring environmental quality in support of "beneficial uses". In accordance with the Great Lakes Water Quality Agreement, the parties, jurisdictions, and the International Joint Commission have been measuring progress by the completion and submission of Stage 1, 2, and 3 Reports or by citing the number of beneficial uses restored and the number of Areas of Concern delisted.

Annex 2, section 4(c) of the Great Lakes Water Quality Agreement calls for the Parties :

> **"to classify Areas of Concern by their stage of restoration progressing from the definition of the problems and causes, through the selection of remedial measures, to the implementation of remedial programs, the monitoring of recovery, and, when identified beneficial uses are no longer impaired and the area restored."**

Classifying the RAPs according to progress on implementation and monitoring of recovery, affords the opportunity to recognize the success with local communities and strengthen the program basin-wide. Formal recognition for incremental milestones gives credit to the extensive degree of effort, while recognizing that more needs to be done or that a period of natural recovery is required before delisting can occur.

RAPs require a long-term commitment in order to restore environmental quality. A record of success is necessary to maintain and broaden partnerships, and to intensify the momentum for Great Lakes rehabilitation and protection. This examination is an attempt to a measure incremental progress toward fully achieving the environmental goals and restoration targets at the Areas of Concern.

We recognize that this is dynamic process, requiring continual reassessment as the status of RAP implementation changes. For example, in some of the AOCs, major projects are just

getting underway now that planning has been completed. These activities are only marginally accounted for in our analysis, since the planned interventions have not yet been taken. Nevertheless, the fact that a RAP has reached the point at which a major project can be launched is itself a clear success. Other forms of progress include the establishment of local, sustainable frameworks to continue RAP implementation for the long term. Multi agency and binational cooperative arrangements are further also markers of achievement that the RAP process enables. We focus on successes in the context of environmental actions or interventions enacted and the environmental response realized.

MEASURING STEP-WISE, INCREMENTAL PROGRESS

One approach that has been used In the past few years portrays a RAP's status with a "clock" or pie diagram. The diagram is intended to depict the extent to which planning, implementation, and environmental restoration are complete. Figure one illustrates the location of each of the Canadian AOCs and their current status. In each RAP status pie diagram, the first three quadrants represent problem identification (Stage 1), plan preparation (Stage 2), and plan implementation (component of Stage 3). The fourth quadrant represents the degree to which the environment has been restored in the context of meeting the Area of Concern's restoration targets. The shaded portion of each quadrant represents the extent of progress the Remedial Action Plan has made in a given phase of the program. Within any given status pie diagram, progress in Stage 2 could be depicted as occurring simultaneously in planning and implementation. This demonstrates that implementation is ongoing and not contingent on completion of the overall plan.

Implementation is ongoing and not contingent on completion of the overall Stage 2 plan.

Figure 1: Location and current status of the Canadian Areas of Concern

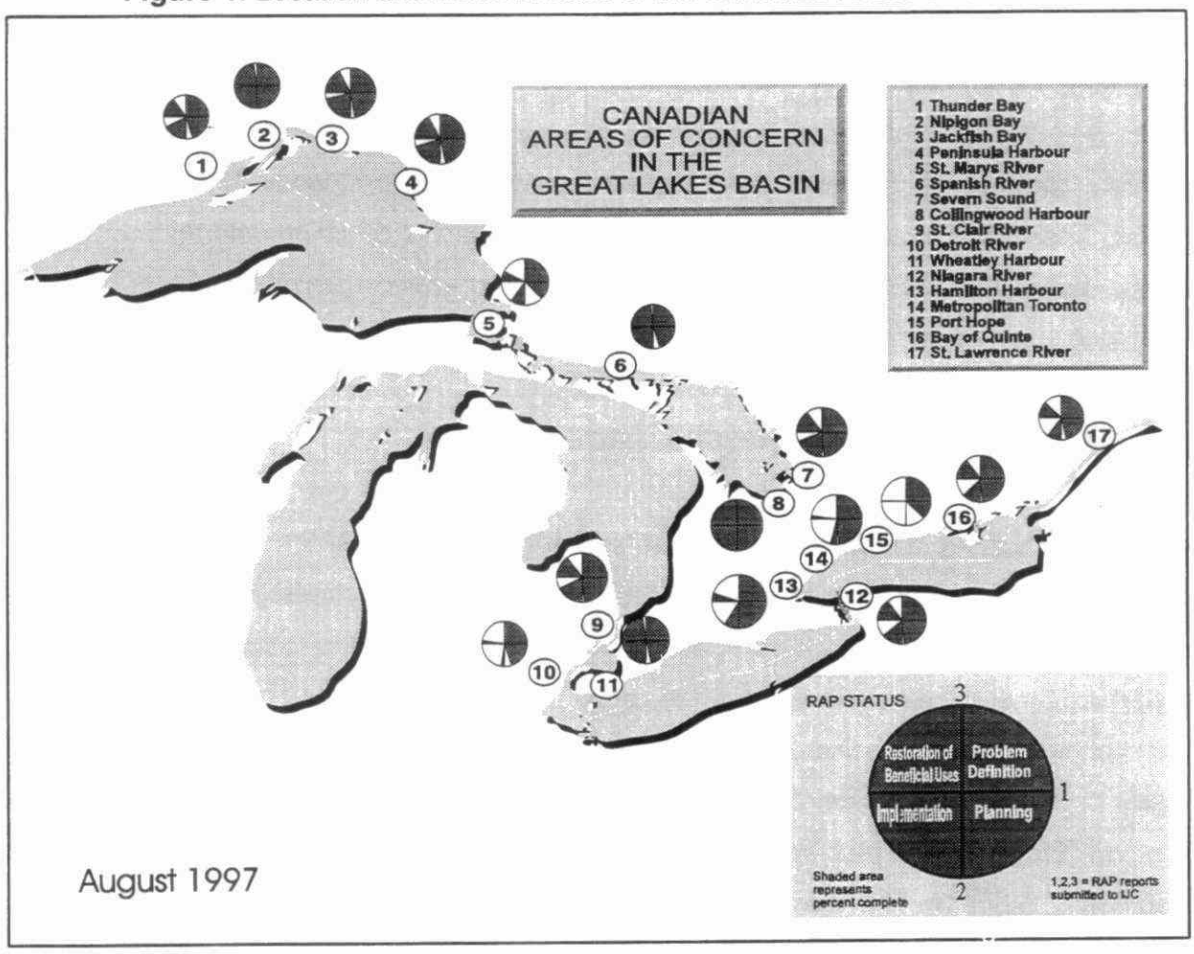
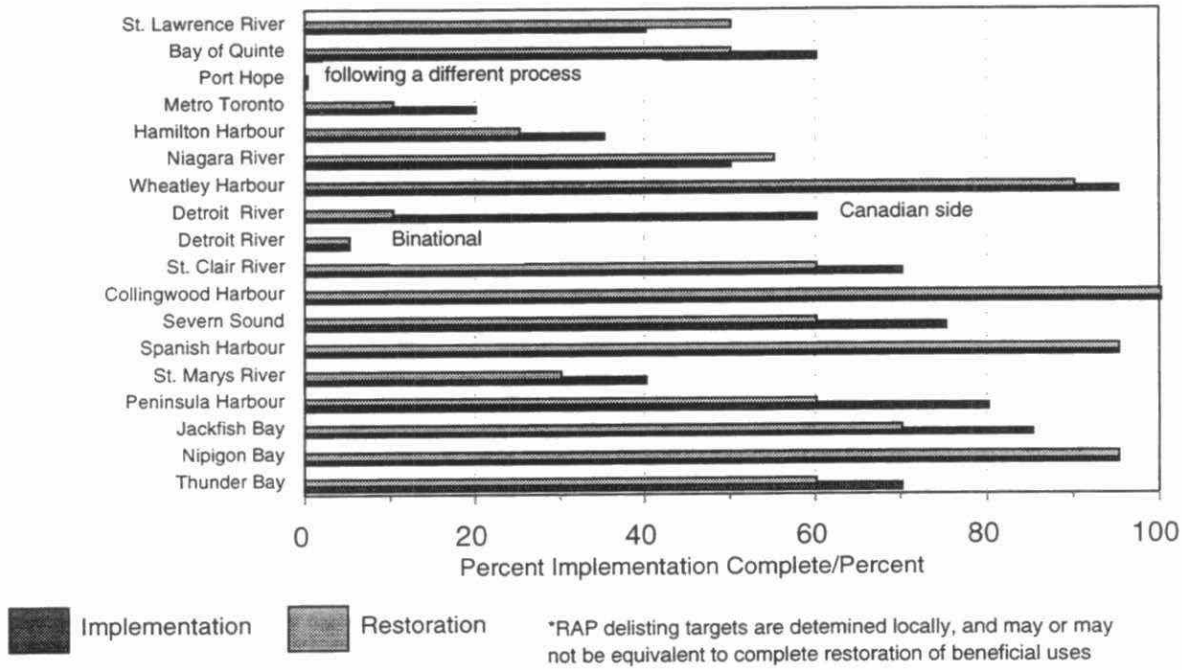


Figure 2 presents a synopsis of progress for each Area of Concern. The mean degree to which planned actions were implemented across all Canadian AOCs by July 1997 was 57%±35%, with the mean degree of attainment of the restoration targets being 51%±33%. The basis for the values portrayed in Figure 2 is detailed in the Remedial Action Plan Update (COA RAP Steering Committee 1997) and summarized below, in the site-by-site analysis.

Figure 2: Progress on RAP implementation and achievement of restoration targets



PROGRESS VARIES WITH THE NATURE OF THE IMPAIRMENT

It is instructive to examine the variability associated with progress in restoring the beneficial uses. Table 1 presents the number of Canadian Areas of Concern that have particular beneficial uses designated as either impaired or requiring further assessment. Those attributes related to contaminated sediment and habitat destruction are reflected broadly throughout the basin. Of particular note is that eutrophication remains to be a problem, despite the present perception that conventional pollutants are no longer an issue and that toxic chemicals must be the focus of our abatement programs.

Table 2 shows the current status in restoring the impaired beneficial uses in the Canadian Areas of Concern. In summarizing the current status for each impairment, Table 2 notes in parentheses, the number of AOCs that the onset of the program considered the beneficial use to be either impaired or potentially impaired. In several cases, it was uncertain as to whether a particular beneficial use

Of particular note is that eutrophication remains to be a problem, despite the present perception that conventional pollutants are no longer an issue and that toxic chemicals must be the focus of our abatement programs.

was impaired, and further assessment was required. The actual values we used to estimate progress in restoring beneficial uses only considered those cases where changes in the status of an impairment was due to implementing a remedial action. The values then, did not include those uses being redesignated unimpaired based on a more in-depth assessment. As well, in some instances, some beneficial uses were originally designated as impaired due to a misinterpretation of the intent of the GLWQA . This was the case, for example, where RAPs considered that exceeding a sediment chemical guideline implied that there were restrictions on dredging, even though no dredging was taking place or predicted to take place at that location. (Contaminants in sediment are considered in the context of impairments such as degraded benthos, consumption advisories, and others.) Therefore, for the purposes of calculations, only progress on those beneficial uses that were still considered impaired or requiring further assessment at the start of the study in 1997 were included.

Table 1: AOCs reporting a beneficial use as impaired or requiring further assessment (1997)

Beneficial Use Impairment	Number of AOCs
consumption advisories	9
tainting of fish and wildlife	2
degraded populations	9
fish tumors	5
bird/animal deformities	1
degraded benthos	12
restrictions on dredging	11
eutrophication	10
restrictions on drinking water	3
beach closings	10
degraded aesthetics	9
added costs	2
degraded plankton	4
loss of habitat	12

As illustrated in Table 2, actions directed at fish and wildlife habitat, and improving population health are more advanced than those for which bacteria and nutrients are problematic. RAPs

have made substantial progress in habitat rehabilitation, partially a strong reflection of the commitment of land-owners and volunteers. Public involvement in RAPs has been a major breakthrough for ecosystem management and recovery (Hartig and Zarrul 1992). RAP success depends on accomplishing key elements, and often these are most visible through short-term, focused projects such as habitat rehabilitation (Figure 3A). This is a clear illustration of how a step-wise approach achieves incremental gains in ecological integrity.

With governments focusing on reducing loadings of chemicals from industrial sources, extensive abatement activities have advanced point source control, resulting in declining levels of contamination in water, sediment and biota. This is reflected in the decline of fish advisories throughout the AOCs and reported by the Ontario Government (MOEE 1997).

RAP success depends on accomplishing key elements, and often these are most visible through short-term, focused projects such as habitat rehabilitation

Conversely, the diffuse nature of nutrient and bacterial inputs, nonpoint source inputs and combined sewer overflows, continues to require considerable effort. Without exception, funding is the major concern of agencies and the public involved in implementing RAP recommendations (MacKenzie 1996). The availability of adequate financial resources to address infrastructure problems is a common concern across the RAPs. The current climate of provincial and federal resource restraints means that limited resources are available to implement storm and wastewater controls at a rate anticipated when RAPs began. Nevertheless, considerable progress has been made in demonstrating new, cost-effective technologies that are being effective at controlling nutrients and bacterial loadings (Cleanup Fund 1997).

Figure 3A: Mean degree of progress on restoring beneficial uses in the Canadian Areas of Concern

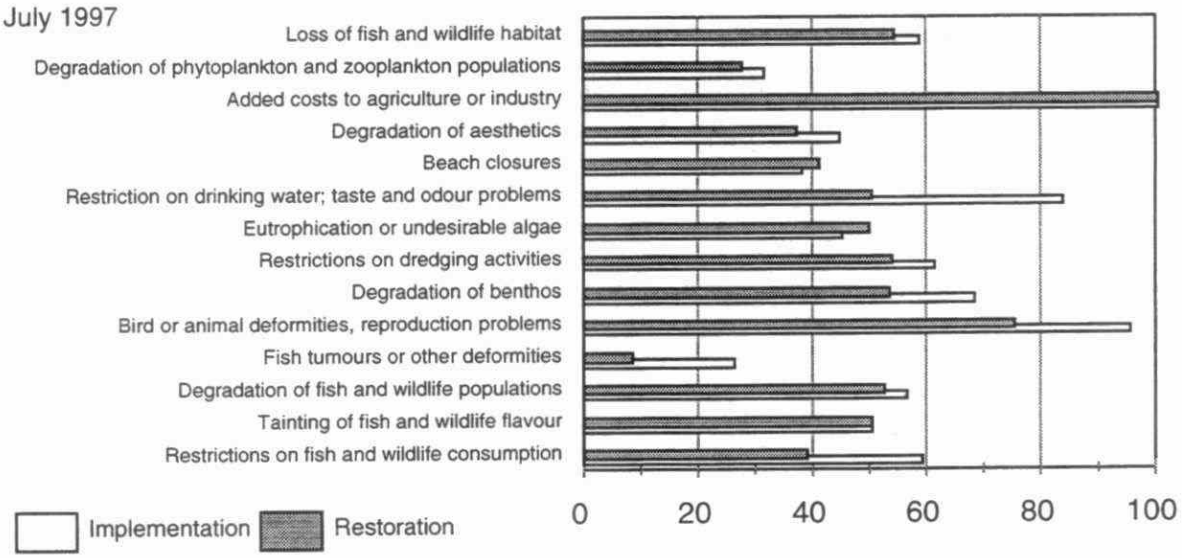


Table 2. Status of actions and recovery of beneficial uses. Values in parentheses refer to the number of AOCs which addressed the beneficial use at some point within the past ten years. Where"n" used to estimate the mean value is less than the number in parentheses, it is because impairments were redesignated based on new information, not environmental change due to RAP implementation.

Implementation and Restoration < 50%	# AOCs represented	Implementation and Restoration > 50%	# AOCs represented	Completely Restored
Fish Tumours or Other Deformities	(11), n=5	Restrictions on Fish and Wildlife Consumption	(15), n=9	Added Costs to Agriculture or Industry (4), n=2
Eutrophication or Undesirable Algae	(10), n=10	Tainting of Fish and Wildlife Flavour	(5), n=2	
Beach Closures	(11), n=10	Degradation of Populations	(13), n=9	
Degradation of Aesthetics	(11), n=9	Loss of Habitat	(16), n=12	
Degradation of Phytoplankton and Zooplankton Populations	(8), n=4	Bird or Animal Deformities, Reproductive Problems	(8), n=1	
		Degradation of Benthos	(14), n=12	
		Restrictions on Dredging	(17), n=11	
		Restrictions on Drinking Water Consumption	(5), n=3	

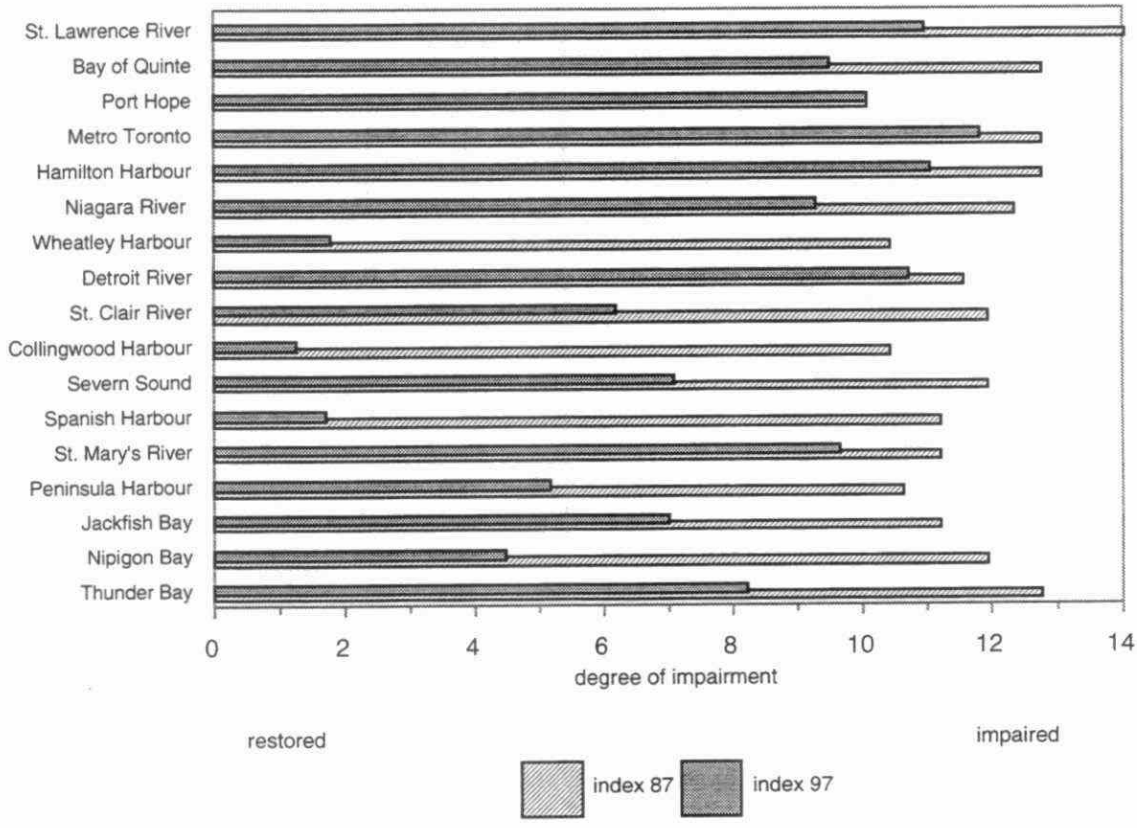
DEVELOPMENT OF AN ENVIRONMENTAL QUALITY INDEX TO MEASURE CHANGE

As an alternative measure of environmental quality at the AOCs, we adapted a water quality index based on an approach developed in British Columbia, and described by Rocchini and Swain (1995). The water quality index has features that quantify the *number of parameters that exceed a standard*, and *the extent to which the standard is exceeded* (Smith 1990). We substituted *the number of parameters exceeded* by the number of beneficial uses impaired, and *the extent* by a qualitative measure of the degree to which the use is impaired, based on a consensus among RAP participants for each of the Areas of Concern. The higher the value of the index, the greater the degree of impairment. The lower the value of the index, the greater the extent of the improvement of beneficial uses. The index is calculated as follows:

$$EQI=\sqrt{(N*10/14)^2+\Sigma(D_{i^*n}/N)^2)}$$

where: EQI is the environmental quality index; N is the number of beneficial uses impaired, normalized to a scale of 1 - 10; D is the degree to which each of the uses are impaired, on a scale of 1 - 10 with 10 being completely impaired. The maximum value for the index is 14. We used the assumption that at the point of beginning the RAP in 1987, the average degree of impairment was 10 (fully impaired). Therefore, if the average degree of restoration of beneficial uses for an AOC was 60%, then the degree of impairment was 40% and the value for D was 4. With no clear rationale for ranking the environmental or social importance of the beneficial uses, all were weighed equally. Similarly, we considered the number of impairments to be equally important as the extent to which they are impaired. The extent to which a beneficial use had recovered was based on our interview data and a consensus-based system. While we recognize that many impairments are interrelated, the relative values should still provide insight into whether ecosystem quality has improved.

Figure 3B: Environmental Quality Index for the Areas of Concern showing improvements from 1987 to 1997.



The mean environmental quality index in 1987 was 11.7, with an improvement to 7.7 by 1997. Based on our knowledge of environmental conditions at the AOCs, values less than six represent considerable recovery. Such is the case for Nipigon Bay, Peninsula Harbour, Spanish Harbour, Collingwood Harbour (delisted), and Wheatley Harbour (Figure 3B).

What follows is a site by site analysis of progress for each of the Canadian Areas of Concern, that considers progress on restoring those beneficial uses that are relevant to the particular AOC.

Thunder Bay

Thunder Bay is located on the north shore of Lake Superior. The Area of Concern extends about 28 kilometres along the shoreline and up to 9 kilometres offshore. Thunder Bay is a major Canadian port and has one of the largest grain handling harbours in the world. Water quality problems are primarily a result of discharges from the pulp and paper products and wood preservation industries.

THUNDER BAY USE IMPAIRMENTS	STATUS
Restriction on fish and wildlife consumption	Impaired
Degradation of fish and wildlife populations	Impaired
Fish tumours or other deformities	Impaired
Bird or animal deformities, reproduction problems	Under Assessment
Degradation of benthos	Impaired
Restrictions on dredging activities	Impaired
Beach closures	Impaired
Degradation of aesthetics	Impaired
Added costs to agriculture & industry	Impaired
Degradation of phytoplankton and zooplankton communities	Impaired
Loss of fish and wildlife habitat	Impaired

Fish and wildlife populations and habitat are impaired due to shoreline hardening, pollutants, and mill waste. Habitat improvements have resulted from the dredging of these wastes, decreased organic loadings, and the installation of secondary treatment plants at two mills. Walleye spawning habitat newly created by the RAP is being actively used. Fish populations which were originally limited by low levels of oxygen and high biological oxygen demand are now characterized by increased populations of a wider variety of species. An effort to rehabilitate lake trout affected by lamprey predation has proved to be extremely successful. Thunder Bay now yields more lake trout per hectare than anywhere else in North America.

Local observations of fish tumours are similar to those found in relatively pristine areas and are not clearly linked to measurable pollutants. No incidences of deformities in cormorants have been reported recently (1996), furthermore, the cormorant population has increased by 10 percent in the last three years. The general perspective is that no measured contaminant is responsible for any observed deformities, with improved reproduction supporting this hypothesis.

Fish advisories due to mercury have been lifted for smaller size classes. This reflects significant decreases in mercury loadings to the system following the closing of a chlor-alkali plant in 1977. Historic anoxia due to high organic enrichment previously resulted in the

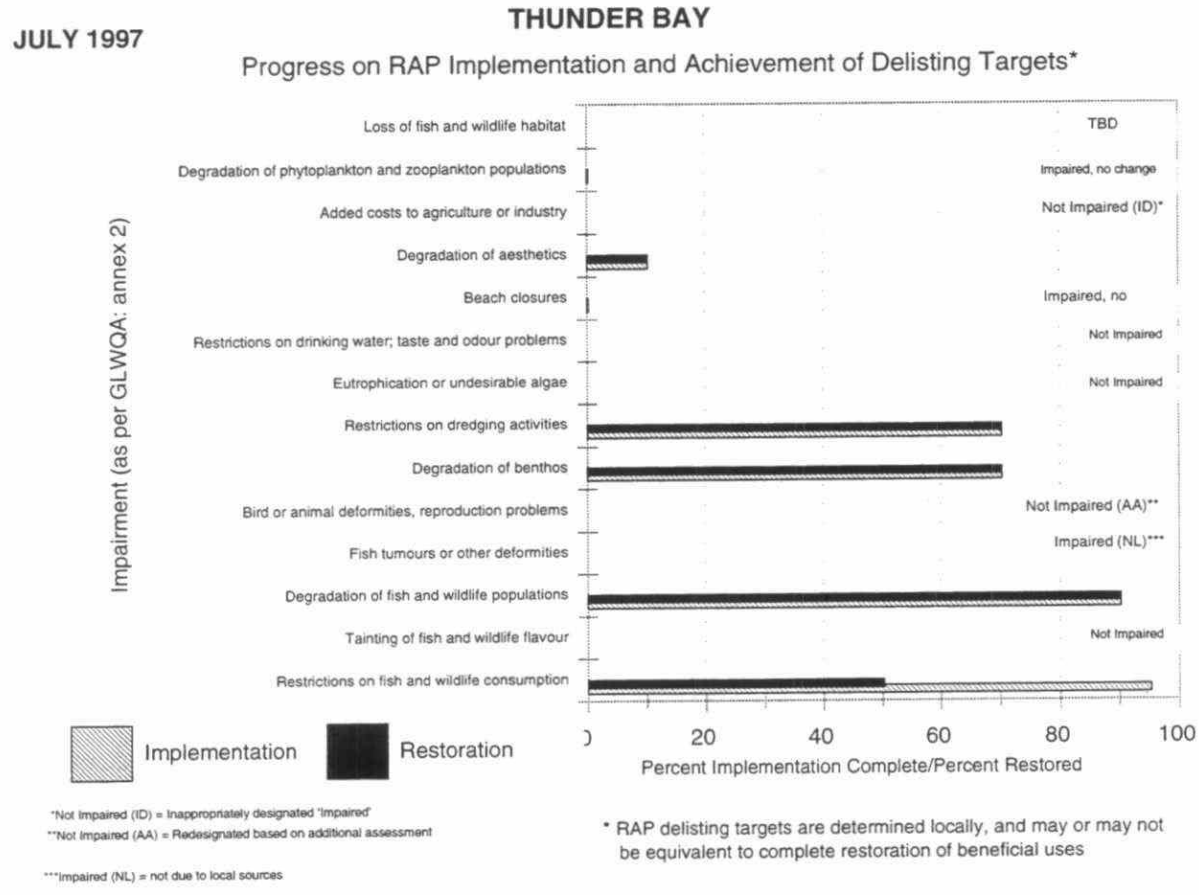
complete absence of benthos in large zones of the Area of Concern. Loading reductions again are responsible for improved conditions. As a consequence of source control and navigational dredging, benthic populations in the Thunder Bay Area of Concern are recovering, and a period of natural regeneration is required for further improvement.

A major obstacle to full environmental recovery is the sediment contaminated with creosote at the Northern Woods site. As of March 1997, a sediment clean-up began at most seriously polluted zone, jointly funded by industry and the provincial and federal governments. This multimillion dollar cooperative initiative will substantially advance the RAP and is an irrefutable success of the RAP process in Thunder Bay.

In addition to mill upgrades, aesthetics are improving due to the continued efforts by the municipalities to enhance the waterfront by activities such as removing old wooden structures and abandoned works, and the creation of park land with habitat features.

Overall, 70 percent of planned actions to be taken to restore beneficial uses in the Thunder Bay Area of Concern have been implemented, and beneficial uses approaching the restoration targets (Figure 4).

Figure 4. Progress on Thunder Bay RAP implementation and restoration of beneficial uses as of July 1997.



Nipigon Bay

Nipigon Bay is located at the most northern point of Lake Superior, approximately 110 kilometres northeast of Thunder Bay. The Area of Concern spans more than 200 square kilometres in area, within a watershed of more than 38,000 square kilometres. Two communities are located in the vicinity of the Bay, Red Rock (population: 1,400) and Nipigon (population: 2,400). Use impairments in the area were primarily the result of discharges from Domtar Packaging Ltd., the accumulation of wood fiber and other organic matter from historic log drives, effluent from the Nipigon and Red Rock water pollution control plants and excessive flow variations and water level fluctuations resulting from hydro-generation on the Nipigon River.

NIPIGON BAY USE IMPAIRMENTS	STATUS
Restriction on fish and wildlife consumption	Restored
Tainting of fish and wildlife flavour	Restored
Degradation of fish and wildlife populations	Impaired
Fish tumours or other deformities	Restored
Degradation of benthos	Impaired
Restrictions on dredging activities	Restored
Eutrophication with undesirable algae	Impaired
Degradation of aesthetics	Impaired
Loss of fish and wildlife habitat	Impaired

Consumption advisories for chinook, lake trout, and yellow perch are due to mercury, dioxins, and PAHs. No contaminant sources are from within the Area of Concern, and lakewide and trasboundary initiatives will be required to restore this beneficial use in Nipigon Bay. Historically there were complaints by local citizens of fish tainting. Significant mill process changes that have occurred during the course of RAP implementation have resulted in reduced discharges of chlorinated phenols, the agents responsible for tainting. There have been no reports of fish or wildlife tainting since the inception of the RAP program. The incidences of fish tumours are comparable to background levels and observed deformities are attributable to bird or angler activities, and not contaminants.

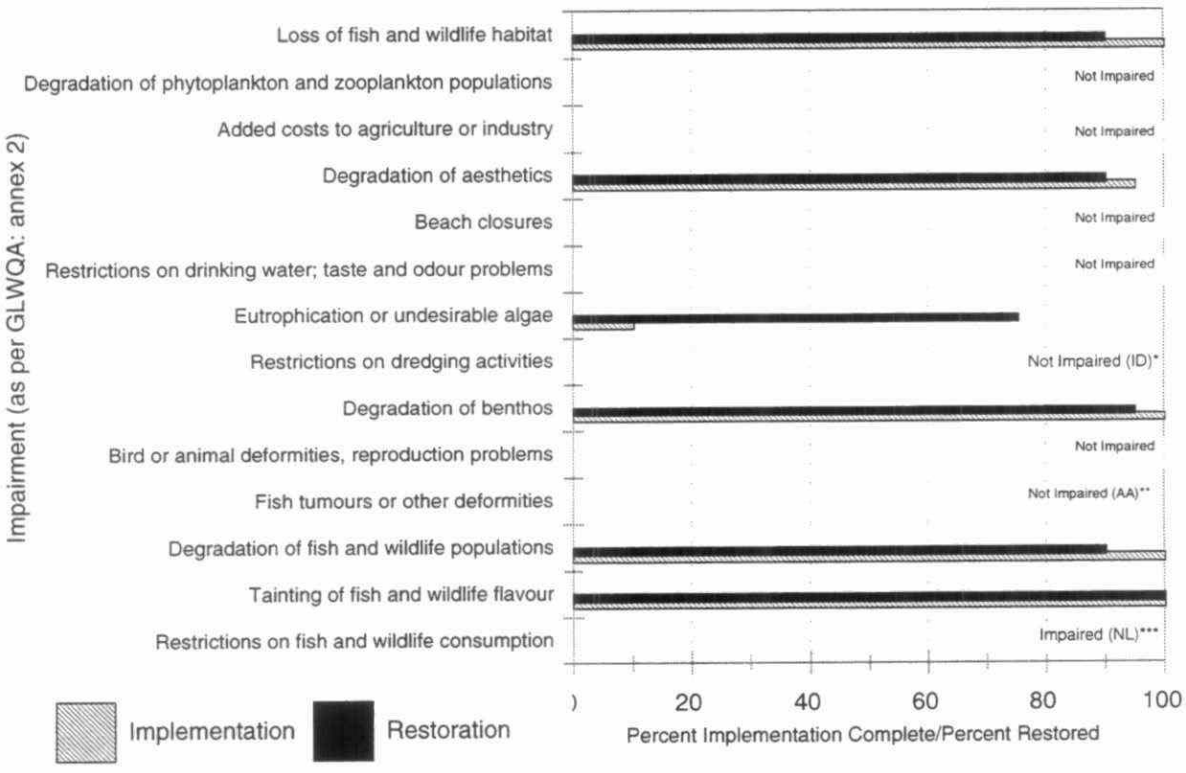
Actions to enhance healthy walleye and trout populations have been remarkably successful. In addition to innovative habitat creation and stocking of adult walleye, a comprehensive water flow control strategy with Ontario Hydro was a cooperative achievement of the RAP. ,. Benthic communities have also responded to the more than $30 million invested for effluent

improvements at Domtar, and the area of degradation now represents a fraction of a percent of the spacial extent of the Area of Concern. No further remedial strategies are planned for sediment. Natural recovery will continue to be monitored.

The foaming and odour problem at Domtar mill has been abated. Odour problems continue to arise from the Nipigon Sewage Treatment Plant and will remain an issue until the plant is upgraded. Although algae have been observed on walleye spawning grounds, subsequent investigations have shown that walleye spawn in these areas successfully. The charaphytic algae require oligotrophic to mesotrophic conditions, and indicate the absence of eutrophic conditions for the Area of Concern in general.

Based on remedial actions to date, which have included aquatic habitat restoration, and effluent treatment at the Domtar Packaging Ltd. implementation is 95 percent complete. Beneficial uses are close to being fully restored, and in the near future, Nipigon Bay will no longer have the attributes of an Area of Concern(Figure 5).

Figure 5: Progress on Nipigon Bay RAP implementation and restoration of beneficial uses as of July 1997.



*Not Impaired (ID) = Inappropriately designated 'Impaired'
**Not Impaired (AA) = Redesignated based on additional assessment

* RAP delisting targets are determined locally, and may or may not be equivalent to complete restoration of beneficial uses

Jackfish Bay

Jackfish Bay is located along the north shore of Lake Superior, approximately 250 kilometres northeast of Thunder Bay. The Area of Concern consists of the 14 kilometre reach of Blackbird Creek between the Kimberly-Clark Canada Inc. pulp mill and Jackfish Bay, including Lake A, Moberly Lake, and Jackfish Bay itself. Blackbird Creek has received the wastewater discharge from the mill since 1948, and both Lake A and Moberly Lake have experienced significant in-filling with wood fiber and other solids. Kimberly-Clark effluent, non-point sources, in-place sediment contamination, and spills have contributed to use impairments.

JACKFISH BAY USE IMPAIRMENTS	STATUS
Restriction on fish and wildlife consumption	Under Assessment
Degradation of fish and wildlife populations	Impaired
Fish tumours or other deformities	Impaired
Bird or animal deformities, reproduction problems	Under Assessment
Degradation of benthos	Impaired
Restrictions on dredging activities	Impaired
Degradation of aesthetics	Impaired
Loss of fish and wildlife habitat	Impaired

There are consumption advisories for large size classes of lake trout (mercury, PCBs) and whitefish (dioxins, furans). Incremental improvements followed the upgrades at the Kimberly-Clark pulp mill and advisories have been lifted for lake trout of smaller size classes. . Advisories are anticipated to remain for some time since historical deposits of Hg are present at more than 50 metres depth, for which source control and natural recovery is the selected sediment management strategy.

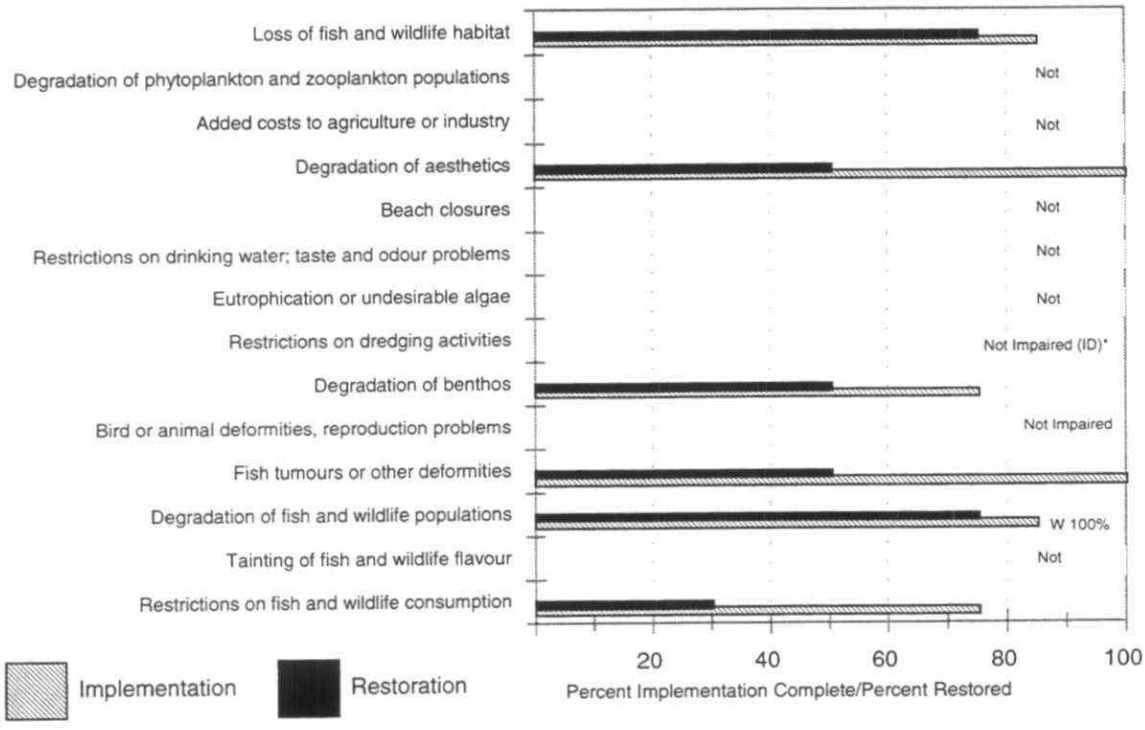
Recent studies have signaled that fish populations in Blackbird Creek are beginning to respond to mill improvements. The creek originally sustained a speckled trout fishery, but due to the toxicity of the Kimberly-Clark pulp mill effluent, fish populations were degraded. As an outcome of improved effluent quality, trout are again returning to the creek. In Jackfish Bay itself, dissolved oxygen conditions are increasing and suckers are spawning. Lesions in whitefish, which were originally thought to be linked to the mill effluent, are believed to be cormorant-related injuries. While reproductive problems do occur in suckers in the vicinity of the pulp mill, however, research has not establish that the pulp mill effluent is the cause. For comparison, neither herring gulls nor their eggs showed impairments due to contaminants in Jackfish Bay. Their reproductive rate is comparable to regional values in areas free from any industrial

discharge, and appears to be governed by natural phenomena such as seasonal variation in temperature and food availability.

For decades, much of Jackfish Bay was devoid of benthos due to sediment contamination and organic loadings from the pulp mill. With source control and effluent no longer being acutely lethal, the appearance of oligochaetes in Blackbird Creek signals important first steps toward recovery. The long-term goal for this Area of Concern is to eliminate the effluent discharge to Blackbird Creek entirely, until which time impairments will remain. The option to divert the effluent into Lake Superior was rejected by the RAP Team and Public Advisory Committee on the basis that it constituted a dilution action, rather than source control.

The environmental response to upgrades at the Kimberly-Clark mill represents a 70% advance in the restoration of beneficial uses (Figure 6). With source control and natural recovery selected as the sediment management approach, no further action beyond monitoring is anticipated until technology is available to completely eliminate the pulp mill effluent through a closed loop system.

Figure 6: Progress on Jackfish Bay RAP implementation and restoration of beneficial uses as of July 1997



*Not Impaired (ID) = Inappropriately designated 'Impaired'
**Not Impaired (AA) = Redesignated based on additional

* RAP delisting targets are determined locally, and may or may not be equivalent to complete restoration of beneficial uses

Peninsula Harbour

Peninsula Harbour is located on the northeastern shore of Lake Superior, approximately 290 kilometres east of the City of Thunder Bay and extending approximately 4 kilometres into Lake Superior. The town of Marathon (population: 6,000) lies on the southeast shore of the harbour. The principal industry in Marathon is a bleached kraft pulp mill complex owned by James River-Marathon, Limited. Historical discharges from the pulp mill and the Marathon Water Pollution Control Plant have contributed to the use impairments in this Area of Concern.

Peninsula Harbour Use Impairments	Status
Restriction on fish and	Impaired
Degradation of fish and wildlife populations	Impaired
Fish tumours or other deformities	Under Assessment
Degradation of benthos	Impaired
Restrictions on dredging activities	Impaired
Loss of fish and wildlife habitat	Impaired

Fish consumption advisories have declined substantially, and lake trout advisories for smaller size classes have been lifted all together, in response to the closing of the chlor-alkali plant in 1977 and the concurrent elimination of Hg discharges. Consumption advisories for lake trout are now comparable to those in other parts of Lake Superior. Step-wise progress in environmental recovery are a result of upgrades at the Marathon Water Pollution Control Plant and the James River-Marathon Ltd. bleached kraft pulp mill. Environmental concentrations of chlorinated organic compounds have declined, and the mill has eliminated the discharge of dioxins.

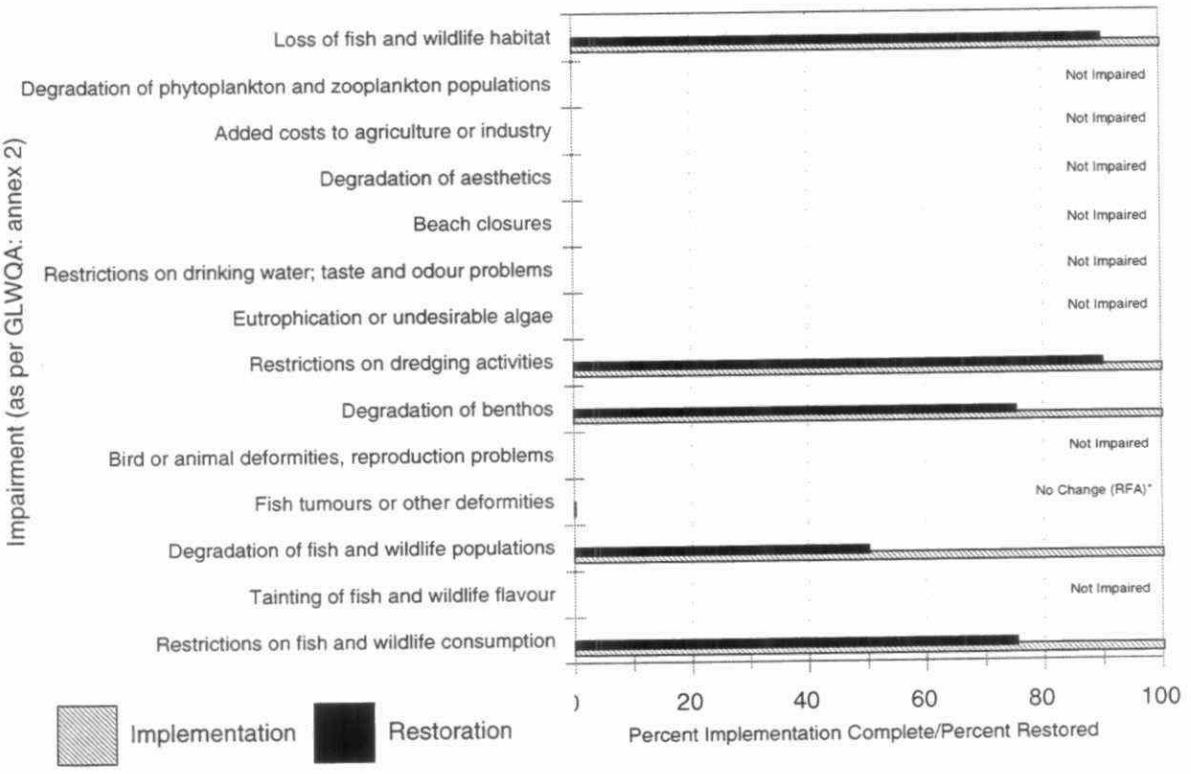
Along with historical contamination, over fishing and the introduction of the sea lamprey also impaired fish populations in Peninsula Harbour. Fish stocking has been ongoing since 1983 and is scheduled to end in 1997. Historic lake trout spawning grounds along the shorelines that

were destroyed through the accumulation of organic matter through industrial activities, are recovering in response to mill upgrades. Nevertheless, the monitoring data forecasts that recovery to historic conditions is unlikely due to the continued presence of lamprey.

The absence of diverse benthic communities in near shore zones is a result of large volumes of woody debris from historical booming activities. Recent studies have shown that the wood material is degrading. The management option of natural recovery rather than active intervention is currently being examined.

The closure of the chlor-alkali plant, and mill and water pollution control plant upgrades, represent 80 percent of planned actions to be taken to restore beneficial uses should a sediment intervention be selected. If there is no active sediment clean-up, then this RAP is fully implemented, with monitoring required to track restoration of beneficial uses. Overall, measurable progress in restoring the beneficial uses has resulted from the investments to abate of point source discharges (Figure 7).

Figure 7: Progress on Peninsula Harbour RAP implementation and restoration of beneficial uses as of July 1997



* RFA = Requires Further Assessment

* RAP delisting targets are determined locally, and may or may not be equivalent to complete restoration of beneficial uses

St. Mary's River

The St. Mary's River is a 112 kilometre connecting channel between Lakes Superior and Huron. Water quality, sediment quality and biota remain impaired on the Ontario shoreline due in large part to major point source discharges. Sources include Algoma Steel, two Ontario water pollution control plants, St. Mary's Paper, one Michigan wastewater treatment plant. Combined sewer overflows in Michigan and wet weather by-pass events in Ontario contribute to the use impairments. Loss of wetlands and rapids habitat due to urban/ industrial development and navigational structures effect fish and wildlife populations. Michigan and Ontario have a formal binational agreement to jointly develop this RAP

ST. MARY'S RIVER USE IMPAIRMENTS	STATUS
Restriction on fish and wildlife consumption	Impaired
Tainting of fish and wildlife flavour	Under Assessment
Degradation of fish and wildlife populations	Impaired
Fish tumours or other deformities	Impaired
Degradation of benthos	Impaired
Restrictions on dredging activities	Impaired
Eutrophication with undesirable algae	Impaired
Beach closures	Impaired
Degradation of aesthetics	Impaired
Loss of fish and wildlife habitat	Impaired

Fish advisories for walleye, longnose sucker, and chinook are due to mercury and PAHs from discharges such as Algoma Steel, St. Mary's Paper, and the East End Water Pollution Control Plant. Algoma Steel has constructed a filtration plant to reduce suspended solids and coal tar compounds in their effluent, and process changes at St. Mary's Paper have reduced contaminant loads to the river. These steps will help to improve local conditions, although advisories will remain until a management plan to remediate sediment contaminated with mercury and PAHs is implemented. Despite periodic detection of elevated concentrations of phenols, tainting of fish has not been reported.

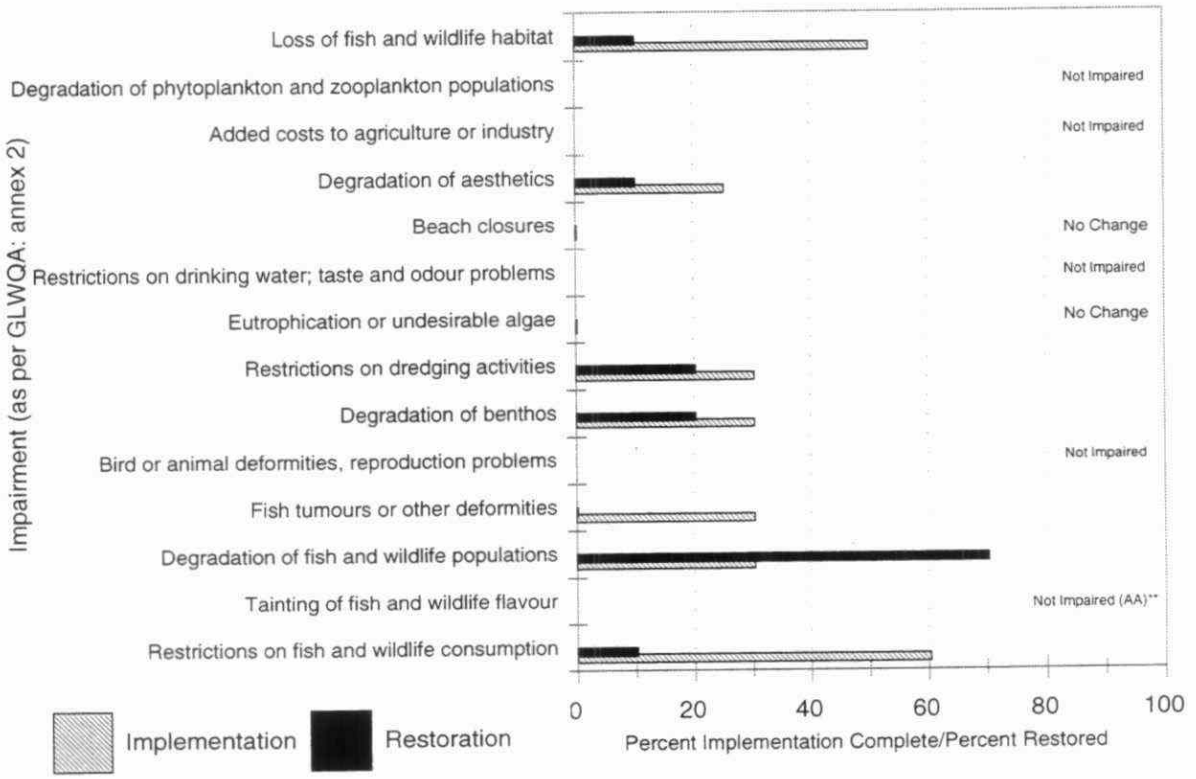
Lamprey predation, over-fishing, and pollutants have degraded of fish populations. Experimental lamprey traps have been coupled with stocking in an effort to correct imbalances due to exotic species. Expectations are that further recovery is imminent in response to these actions, as well as abatement activities of Algoma Steel.

Other programs will help to improve natural features. Urbanization, erosion, and fluctuating water levels have resulted in impaired fish habitat in the vicinity of tributaries. Existing habitat

has been mapped in conjunction with watershed planning, and relevant language has been incorporated into the municipal plans for Sault Ste. Marie, Ontario.

Preliminary data indicate a decline contaminant levels and a fewer and finer pulp fibers in the surface layers of sediment cores. This progress coincides with processes changes at St. Mary Paper and the construction of a filtration plant for the terminal basins at Algoma Steel in 1990. Residual concentrations of oils and greases, metals, and PAHs in sediment necessitate restrictions on open water disposal of dredged sediment for the Algoma Slip and the Bellview Marine Park areas.

Figure 8: Progress on St. Mary's River RAP implementation and restoration of beneficial uses as of July 1997



**Not Impaired (AA) = Redesignated based on additional assessment

* RAP delisting targets are determined locally, and may or may not be equivalent to complete restoration of beneficial uses

Substantive actions are still required to confront the challenge of eutrophication downstream of the primary treatment East End Water Pollution Control Plant, and a repercussion of the combined sewer overflows in both Ontario and Michigan.

The RAP participants concluded that the point source improvements represent 40 percent of the necessary actions required to restore beneficial uses and have resulted in measurable improvements in the beneficial uses (Figure 8).

Spanish Harbour

The Spanish Harbour Area of Concern is located on the north shore of the North Channel, Lake Huron and encompasses the lower 53 kilometres of the Spanish River. The causes of environmental degradation were pulp and paper mill and sewage treatment plant effluents at Espanola. Additional impacts are due to historic and ongoing mining activities in the Sudbury basin.

SPANISH HARBOUR USE IMPAIRMENTS	STATUS
Restriction on fish and wildlife consumption	Impaired
Degradation of fish and wildlife populations	Restored
Bird or animal deformities, reproduction problems	Unimpaired
Degradation of benthos	Impaired
Restrictions on dredging activities	Impaired
Beach closures	Restored
Added costs to agriculture and industry	Restored
Degradation of phytoplankton and zooplankton communities	Unimpaired
Loss of fish and wildlife habitat	Restored

Upgrades to the mill which operates as a state-of-the-art facility, have contributed dramatically to environmental recovery. In 1994, fish consumption advisories for perch were removed. The consumption advisories that remain are due to lakewide conditions and are not attributable to local sources. Wildlife consumption advisories are also a regional issue, and are not a result of local sources. A lakewide or regional management plan will be needed to fully restore this beneficial use. At one time the area was characterized by the absence or depressed populations of four fish species, due to bark/fibre deposits. Conditions, have improved significantly, with a diversity of valuable fish and wildlife habitat now available with no traces of bark or fibre. In 1994, a six-year muskellunge reintroduction program was initiated by Friends of the Spanish River, in partnership with government, industry, and community members, in the spirit of the RAP process.

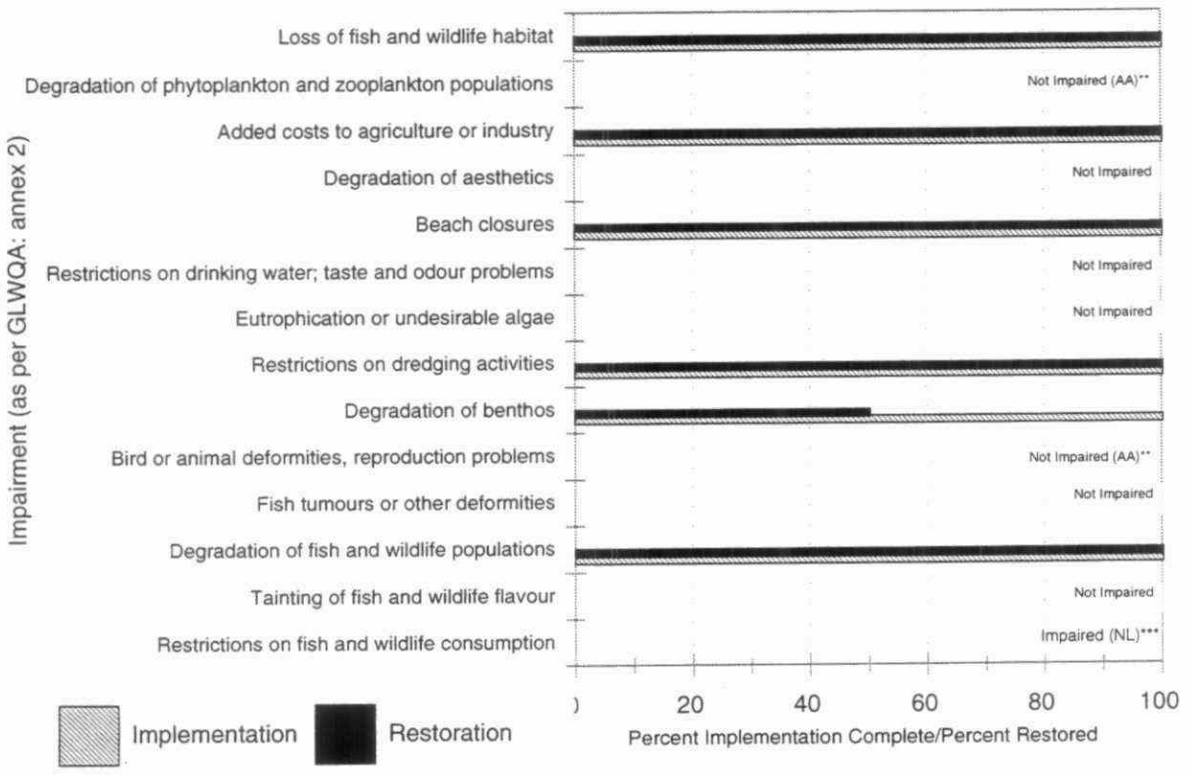
Recent assessments resolved the previously unknown status of beneficial uses. By 1994, field studies provided evidence that there were no bird or animal deformities or reproductive problems. The phytoplankton and zooplankton populations of Spanish Harbour were judged to be typical of the North Channel, Lake Huron. In addition, bacterial contamination from sea gulls has ceased with the closure of a nearby landfill, and beaches are again swimmable. Upgrades at the sewage treatment plant have also contributed to appreciable improvements.

The benthic community is moderately to slightly depressed in some zones, however, no chronic toxicity has been observed in sediment bioassays. The sources of the problem originate outside the Area of Concern, through the transport and deposition of atmospheric emissions from the smelters in the Sudbury area and run off from mine tailings. Monitoring will continue to track sediment recovery anticipated to result from loading reductions underway at the smelters.

Also a result of long-range transport from Sudbury, E.B. Eddy incurred an added cost to operate due to the need to treat its processing water. With the abatement of emissions in Sudbury, industrial pretreatment of intake water has not been required since 1994.

The efforts at Spanish Harbour are a clear success. Due to substantial efforts to control point sources and improve habitat, implementation is now 100% percent complete, and beneficial uses in Spanish Harbour are virtually restored (Figure 9), a powerful statement of accomplishment. Monitoring will continue to track sediment recovery and fish community characteristics.

Figure 9: Progress on Spanish Harbour RAP implementation and restoration of beneficial uses as of July 1997



**Not Impaired (AA) = Redesignated based on additional assessment

***Impaired (NL) = not due to local sources

* RAP delisting targets are determined locally, and may or may not be equivalent to complete restoration of beneficial uses

Severn Sound

The Severn Sound Area of Concern is located in southeastern Georgian Bay and includes Penetang, Midland, Hog, Sturgeon, and Matchedash Bays with significant population centres in Midland and Penetanguishene. The watershed covers an area of 1,000 square kilometres. The primary problem is eutrophication. Sources include sewage treatment plant effluent, agricultural activities, and shoreline development. This problem is especially evident in the constricted embayments on the south shore of the Sound. Additional concerns include shifts in fish communities due to habitat loss and exotic species.

SEVERN SOUND USE IMPAIRMENTS	STATUS
Restriction on fish and wildlife consumption	Impaired
Degradation of fish and wildlife populations	Impaired
Degradation of benthos	Impaired
Restrictions on dredging activities	Impaired
Eutrophication with undesirable algae	Impaired
Degradation of aesthetics	Impaired
Degradation of phytoplankton and zooplankton communities	Impaired
Loss of fish and wildlife habitat	Impaired

Consumption advisories exist principally due to Hg. Former Hg sources included transformers and landfill sites, and between 1976 and 1989, there was a decline in mercury concentrations in sport fish, with elevated levels found mostly in older walleye. Additional declines in contaminant inputs and ambient activities have sanctioned the removal of PCB-driven advisories for carp. Trace organic contaminants now are close to non-detectable in sediment, reducing the risk of food web bioaccumulation.

The fish community in the open waters of Severn Sound is presently imbalanced. Walleye represent less than 1 percent of the community. Efforts are underway to classify, rehabilitate, and protect near shore habitat, and to continue stocking. It is not clear what effect the introduction of zebra mussels, spiny waterfleas, or white perch to the area will have on attempts to establish community balance, and a long-term monitoring program will be required.

A further challenge to restoring the balance is the riparian stream habitat and coastal habitat destruction that has resulted from unrestricted livestock access to the tributaries, shoreline modifications and marine construction. Significant habitat corridors have been restored by restricting livestock access along 48 kilometres of river and retiring valley lands from pasturing,

as elements of the Fish Habitat Management Plan. To date, 129 kilometres or 37 percent of the shoreline has been recognized as unique and essential habitat, including eight provincially significant wetlands. Twelve kilometres of shoreline has been identified as severely degraded, and "in-water" projects and shoreline naturalization are in progress.

Further actions are underway to boost wildlife communities. Priority sites will be planted in cooperation with local landowners to maximize the size of interior forest patches, and the tributary and coastal habitat restoration projects are intended to lead to greater stability of the colonial waterbird and waterfowl communities. The RAP has established an target of restoring five sustainable nesting pairs of wild trumpeter swans by the year 2000. As of 1996, there were more than 40 free flying swans in the area and three successful wild nesting pairs, a striking stride forward.

To address the eutrophic state of Severn Sound, the RAP developed phosphorus loading reduction targets. The reductions from point sources in the Area of Concern require an 80 percent decrease in phosphorus loads from sewage treatment plants from the early 1990s. Presently, more than 60 percent of the loading reduction has been reached or pledged. The target for non-point sources is a reduction of 20 percent of the phosphorus load. Presently, approximately 5 percent has been achieved. In total, at least half of the targeted phosphorus reduction has been achieved from point and non-point sources combined.

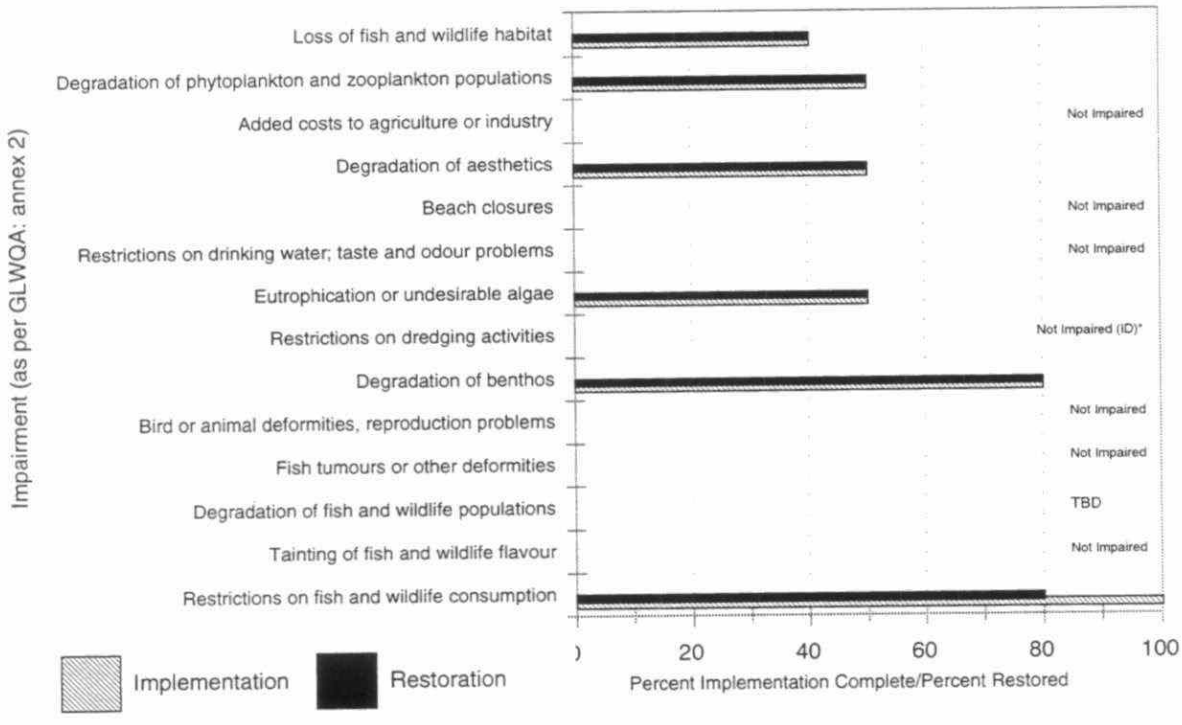
Environmental recovery is conspicuous. While benthic communities convey eutrophic conditions, no chronic toxicity has been observed in laboratory bioassays. Analyses of sediment cores show evidence of the reductions in nutrient loadings. The most notable improvement in the receiving waters has been in Penetang Bay where phosphorus concentrations have declined from approximately 50 micrograms per litre to 20 micrograms per litre.

Despite these considerable gains, aesthetics are still impaired, due in part to the zebra mussel invasion. The original aesthetic problem of high phytoplankton density has been resolved. However, with nutrient controls and zebra mussel activities, improved light penetration is

favouring the proliferation of attached algae, which are reaching objectionable densities in the near shore zones.

The control of eutrophication and efforts to enhance habitat rehabilitation are well underway. Implementation of planned actions is estimated to be 75 percent complete and beneficial uses are responding and approaching the restoration targets (Figure 11).

Figure 11: Progress on Severn Sound RAP implementation and restoration of beneficial uses as of July 1997



*Not Impaired (ID) = Inappropriately designated 'Impaired'
TBD = To be determined

* RAP delisting targets are determined locally, and may or may not be equivalent to complete restoration of beneficial uses

Collingwood Harbour

Located on the southern tip of Georgian Bay in Lake Huron, Collingwood Harbour encompasses 0.8 square kilometres in a watershed that is approximately 33 square kilometres. The harbour was highly eutrophic, with the principal source being the sewage treatment plant. Habitat destruction and contaminant inputs were largely historic and attributed to over a century of industrial activity. In 1994, Collingwood was delisted as an Area of Concern, and remains the only one of 43 locations to date to fully achieve the rehabilitation and protection targets.

COLLINGWOOD HARBOUR USE IMPAIRMENTS	STATUS
Restriction on fish and wildlife consumption	Impaired not due to local sources. IJC concludes Restored
Restrictions on dredging activities	Restored
Eutrophication with undesirable algae	Restored
Loss of fish and wildlife habitat	Restored

Consumption advisories remain for several fish species due to Hg and PCBs, however, there are no local sources and a lakewide approach will be required to restore this beneficial use.

A critical component of the RAP was the strategy to reduce phosphorus loads and control eutrophication. Technical solutions focused on optimizing phosphorus removal at the Collingwood Sewage Treatment Plant. The innovative technology achieved an effluent quality comparable to that of tertiary treatment, but at less than 10 percent of the cost, saving the town at least $8 million. In response to the loading reductions, the harbour is no longer eutrophic. To sustain this accomplishment, a strong emphasis was placed on pollution prevention and water conservation. The Greening of Collingwood continues as a community-based enterprise through the Environment Network, a nonprofit organization established by the Public Advisory Committee in 1993. Their flagship program emphasizes pollution prevention and naturalization for residents, businesses, and industries. The first comprehensive "Green Home Tuneups" in Ontario were completed in Collingwood in 1994.

Efforts were also directed at protecting the existing 96-hectare Collingwood Wetland Complex, controlling the invasion of purple loosestrife in the wetlands, and rehabilitating fish and wildlife habitat in the harbour and the watershed. In the harbour area, bass and pike spawning and rearing habitat was created, as were opportunities for osprey, water birds, amphibians, and

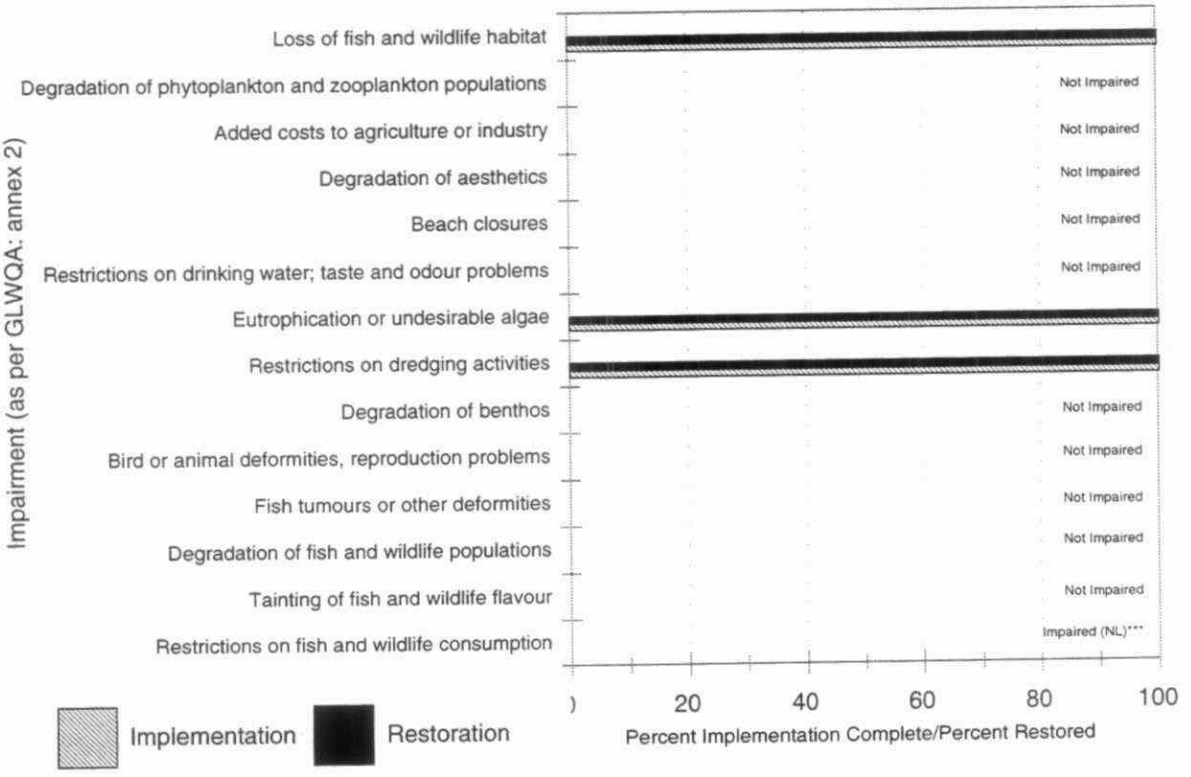
reptiles. In the watershed, bioengineering approach to bank stabilization was used to prevent erosion while incorporating habitat features. Fish populations responded to the initiatives, with the first successful recruitment in the major tributary documented in more than 30 years.

In November 1992, a demonstration project was initiated to safely remove the only sediment in the harbour where contaminants caused chronic toxicity problems. This marked the first entirely biologically-driven sediment clean-up in the Canadian Areas of Concern. Benthos outside the dredged areas of the harbour, such as the approach channel and turning basin, are unimpaired. With the closure of the Collingwood Terminals and the end of grain handling in the harbour, no further navigational dredging is anticipated.

One of the most novel projects designed to raise awareness of the importance of pollution prevention is the environmental theme park, ENVIROPARK. This unique network of play structures was designed to instill in children an understanding of how everyday life has a direct impact on our environment. Instead of the classroom setting, young people learn while they play.

As a result of the community's commitment to the Remedial Action Plan, environmental quality improved dramatically to the point where all the delisting targets were either met or surpassed (Figure 11). Collingwood Harbour was the first Area of Concern in North America to be declared clean, and delisted in 1994.

Figure 11: Progress on Collingwood Harbour RAP implementation and restoration of beneficial uses.



***Impaired (NL) = not due to local sources

* RAP delisting targets are determined locally, and may or may not be equivalent to complete restoration of beneficial uses

St. Clair River

The St. Clair River serves as a connecting channel from Lake Huron to Lake St. Clair. This 64 kilometre connecting channel is an important international waterway, with heavy demands put on it as a shipping channel and as a source of water for power generation, municipal water supply, and industrial cooling and process water. Discharges of chlorinated organic compounds, heavy metals, oils and greases, phenols, and suspended solids from petroleum and chemical industries, combined sewer overflows, sewage treatment plants, spills, as well as historically contaminated sediment pose challenges to restoring beneficial uses. Michigan and Ontario have a formal binational agreement to jointly develop this RAP.

ST. CLAIR RIVER USE IMPAIRMENTS	STATUS
Restriction on fish and wildlife consumption	Impaired
Tainting of fish and wildlife flavour	Under Assessment
Degradation of fish and wildlife populations(*)	Under Assessment
Fish tumours or other deformities	Under Assessment
Bird or animal deformities, reproduction problems	Impaired
Degradation of benthos	Impaired
Restrictions on dredging activities	Impaired
Restriction on drinking water; taste and odour problems	Impaired
Beach closures	Impaired
Degradation of aesthetics	Impaired
Added costs to agriculture & industry	Impaired
Loss of fish and wildlife habitat	Impaired

(*) Will be evaluated upon receipt of fish community goals under preparation by OMNR.

Although consumption advisories exist, there are now restrictions on fewer species, and larger fish are acceptable for consumption since the RAP began. This is a measurable outcome of industrial investment in source control. In particular, mercury levels have dropped substantially since the early 1970s, due to process changes at Dow.

The zone of sediment contamination in the St. Clair River has attenuated from a contiguous 64 km to intermittent pockets through a reach of approximately 6 kilometres south from the Sarnia industrial complex along the Ontario shoreline. Estimated volumes of polluted material have shrunk approximately 75 percent since 1978, and 50% since the inception of the RAP. As with fish consumption advisories, this is largely the result of voluntary and legislated measures including abatement, source control, improved training, and pollution prevention plans by local industries. Nodes of degraded benthos remain in three areas adjacent to point source discharges, and the option of small scale cleanups remain. While confined disposal of contaminated sediment is required following navigational dredging near Walpole, these substantive improvements in sediment quality reflect the concerted efforts of the industrial community.

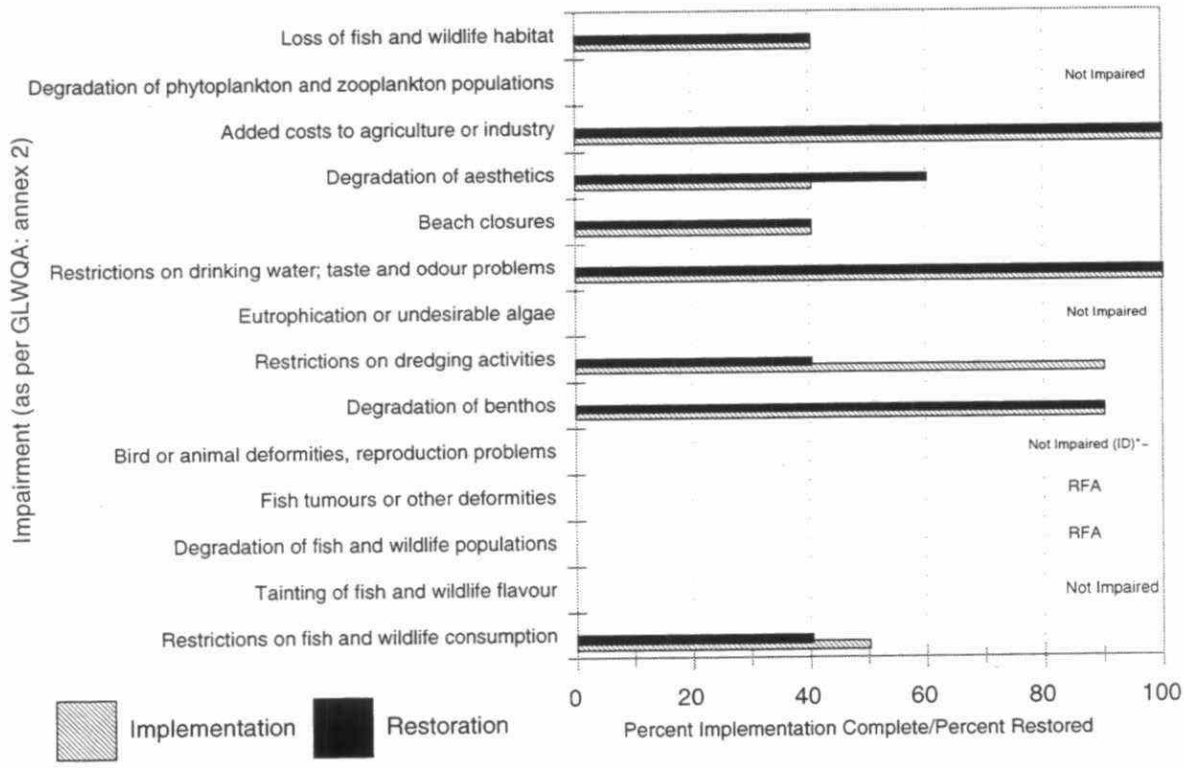
No further evidence of contaminated related effects, such as tainting of fish and wildlife flavour are present. The status of fish and wildlife populations and fish tumours or other deformities still require resolution. Chironomid mouthpart deformities indicate the potential for deformities at other trophic levels, however, to date, none have been found in fish or wildlife. The improved reproductive success of cormorants adds to the burden of evidence that chemicals are not resulting in abnormalities.

Habitat rehabilitation projects are currently underway in three major location and address almost 700 hectares of wetland or terrestrial habitats. Additional work is planned for a further 60 hectares. These measures demonstrate clear progress in strengthening the health of fish and wildlife communities. Also contributing to the quality of habitat are the spill prevention plans and training which have resulted in a decreased frequency and volume of accidental discharges.

Reduced spill incidences have lead to the improved aesthetic quality of the river. The foaming problems, originally thought to be related to organic discharges, have been determined to be a natural occurrence. Oil sheens associated with stormwater runoff from refineries have decreased in parallel improved training. Septic tank connections to the sanitary system in Moore and Sombra townships, and a reduction in combined sewer overflows in Sarnia have also generated notable improvements. Swimming restrictions have been lifted at one public access area, and changed from permanent postings at two additional locations to restrictions for 48 hours after rainfall. There have been no restrictions on drinking water consumption, water plant closures, or complaints of taste and odour problems in the last two years, an indicator that these initiatives are producing real environmental benefits.

The actions to control point and non point discharges, sediment clean-up, and habitat enhancement represent completion of 70 percent of the planned actions to completely restore beneficial uses (Figure 12).

Figure 12: Progress on St. Clair River RAP implementation and restoration of beneficial uses as of July 1997



*Not Impaired (ID) = Inappropriately designated 'Impaired'
**Not Impaired (AA) = Redesignated based on additional assessment
-Subject to BPAC confirmation

* RAP delisting targets are determined locally, and may or may not be equivalent to complete restoration of beneficial uses

Detroit River

The Detroit River is a 51 kilometre international connecting channel linking Lake St. Clair to Lake Erie. The known causes of impairments include urban and industrial development in the watershed, resulting in unacceptable concentrations of bacteria, PCBs, PAHs, metals, and oils and greases. Stormwater runoff, industrial discharges and tributaries in Michigan are also major sources of contaminants. Recent studies demonstrate that at least 90% of municipal loadings originate in Michigan. Additional environmental concerns include exotic species, changes in the fish community structure, and reductions in wildlife populations. Michigan and Ontario have a formal binational agreement to jointly develop this RAP.

DETROIT RIVER USE IMPAIRMENTS	STATUS
Restriction on fish and wildlife consumption	Impaired
Fish tumours or other deformities	Impaired
Degradation of benthos	Impaired
Restrictions on dredging activities	Impaired
Restriction on drinking water; taste and odour problems	Impaired
Beach closures	Impaired
Degradation of aesthetics	Impaired
Loss of fish and wildlife habitat	Impaired

Contaminants have lead to a number of impairments. Fish consumption advisories exist due to mercury and PCBs. Completed and ongoing industrial on-site pretreatment and sewer separation activities in Ontario will not remove the advisories because sources are both upstream of the Area of Concern and originate principally in the US. A recent taste test survey conducted by the Michigan Department of Environmental Quality found low level tainting of walleye, but the cause has yet to be determined. Tumours in fish have been found, and are at frequencies similar to those of other industrialized locations. A clean-up has been initiated on the Monguagon Creek, a 0.7 mile tributary to the Detroit River Trenton Channel that historically received discharges of metals and trace organic compounds. Following the sediment clean-up project and source control measures, tumour levels declined somewhat, however, the linkage is unclear, since as in many cases, the cause of the observed tumours is not known.

The absence of diverse benthic communities is attributed to sediment contamination, and confined disposal is required for navigational dredging. Beach closures result from combined

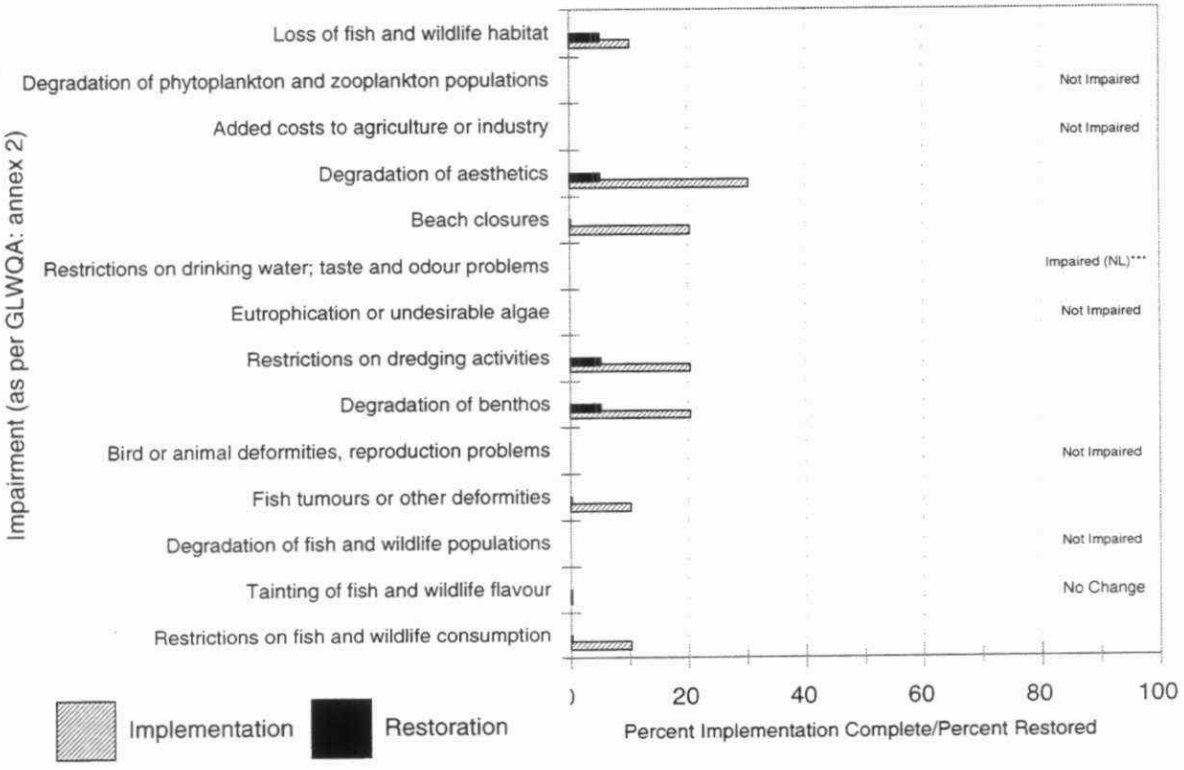
sewer overflows and stormwater sources. As part of a strategy to reduce contamination, the Rouge River National Wet Weather Demonstration Project was initiated and is currently into its fifth year. The project encompasses the design and construction of retention basins to prevent untreated discharges entering into the river from combined sewer overflows and is one facet of a 25-year combined sewer overflow abatement program. A number of sewage treatment plants also discharge directly into the river. Most recently, progress toward restoring beneficial uses includes upgrading the Little River Sewage Treatment Plant and the West Windsor Pollution Control Plant to secondary treatment. A rural non-point source remediation program which began in 1996, includes the implementation of septic system upgrades and livestock waste management practices. These steps mark incremental progress toward restoring beneficial uses.

Aesthetics are impaired primarily due to combined sewer overflows and oil from dischargers and accidental spills. A clear move forward is the decline of oil discharges from oil discharges from 25,000 gallons per day at the onset of the RAP to virtually none since the establishment of oil abatement programs. Taste and odour problems are associated with blue-green algae, the source of which is believed to Lake St. Clair. To improve the aesthetic quality of drinking water, carbon filtration systems were installed in the river's water treatment plants. Any further actions are beyond the scope of the RAP and must be take outside of the AOC.

Fish and wildlife habitat has been degraded through urbanization and industrialization. The Ruwe Marsh rehabilitation project replaced 1,125 metres of an existing finger dyke, and resulted in the protection of 366 hectares of wetland habitat. The Windsor Salt River Front Rehabilitation Project, will result in the creation of up to one kilometre of shoreline, three offshore islands, and a marsh area, thereby providing fish and wildlife habitat, spawning, and nesting areas. Other projects are planned to progressively restore habitat.

While multiple actions have been undertaken in Ontario, from a binational perspective, implementation is 5 percent complete (Figure 13). This relays that the predominance of actions to resolve the problems on the river will require substantive U.S. undertakings. Progress toward completing Canadian actions is estimated as 60 percent complete.

Figure 13: Progress on Detroit River RAP implementation and restoration of beneficial uses as of July 1997



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Wheatley Harbour

The Wheatley Harbour watershed covers 1000 hectares, with the harbour itself 7.5 hectares in area. The harbour is an economically important and viable commercial fishing port. Problems were largely historic with sizable quantities of food processing waste being discharged to the harbour. Current issues include low level contamination of sediment by PCBs, agricultural activities in the watershed, and loss of fish and wildlife habitat.

WHEATLEY HARBOUR USE IMPAIRMENTS	STATUS
Restrictions on dredging activities	Impaired
Eutrophication with undesirable algae	Under Assessment
Beach closures	Under Assessment
Loss of fish and wildlife habitat	Impaired

When Wheatley Harbour was first identified as an Area of Concern, Omstead Foods, a fish and vegetable processing plant discharged PCB-containing food waste with nominal treatment. PCB contamination of sediment and biota resulted. As well, the substantial biological oxygen demand of this material created anoxic conditions. By 1983, the plant had upgraded to secondary treatment, and over the last several years, Omstead Foods has spent in excess of four million dollars in further upgrades. Environmental responses to these industrial investments are pronounced. Fish populations are recovering, and the harbour sustains the largest yellow perch population of any Lake Erie port. Tissue concentrations of PCBs in fish and wildlife are presently comparable to regional values. Although PCBs are at detectable concentrations in wildlife, no physiological impairments have been observed. With source control instituted at Omstead Foods, the RAP sediment management approach is to monitor natural recovery, in conjunction with routine navigation dredging. While confined disposal of dredged material will be necessary until contaminant levels decline below the provincial guideline for open water disposal, the dramatic degree of recovery is an unqualified success.

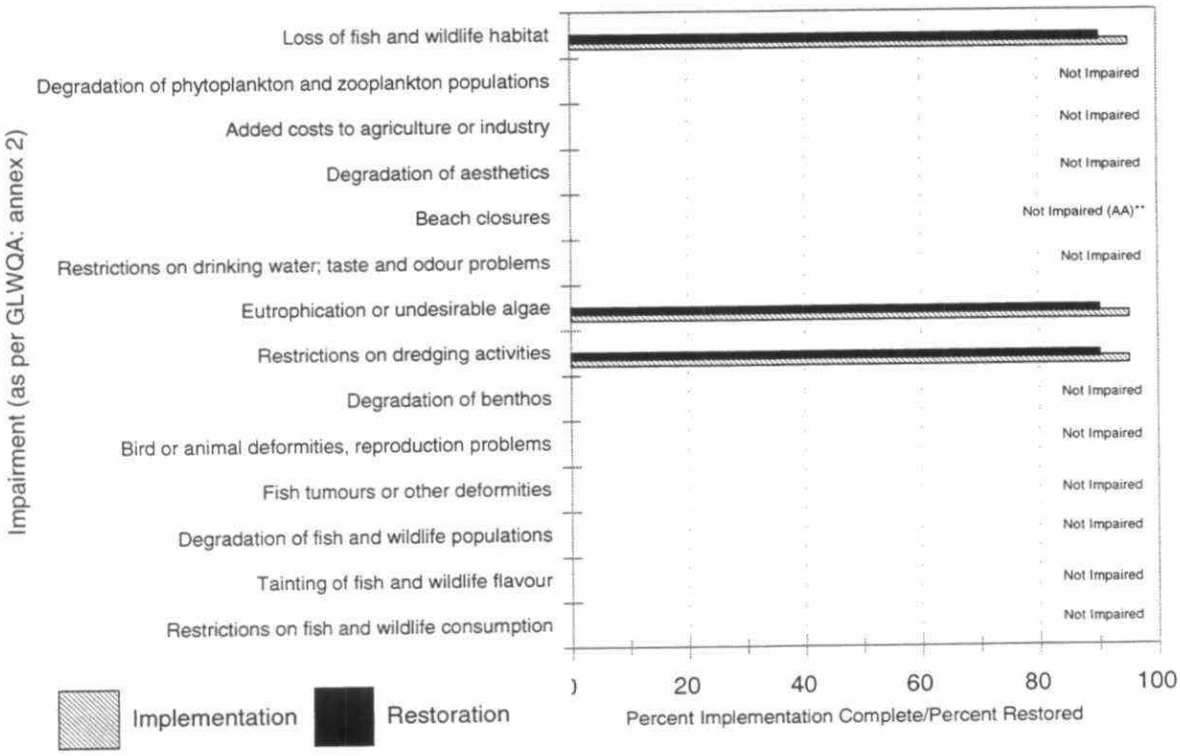
Muddy Creek, which flows into Wheatley Harbour, as well as several upstream wetlands, is degraded due to agricultural practices throughout the region that result in soil erosion and sedimentation. No habitat enhancement is proposed for the port itself, which the community advises remain commercial. The RAP itself cannot advance fish or wildlife habitat opportunities

to the extent needed to improve populations, due to its limited geographic scope, the transient nature of fish and wildlife in the port, and regionally degraded conditions. The RAP does, however, recommend implementing actions through the Lake Erie Lakewide Management Plan, and promotes the Ontario Land CARE (Conservation of Agriculture, Resources and the Environment) Program initiated by the North American Waterfowl Management Plan and delivered on behalf of partner agencies by Ducks Unlimited Canada. An extensive regional approach to establishing permanent cover and buffers along with conservation tillage is required to improve local conditions.

Although swimming is not a desired use in this commercial port, there is the potential for Wheatley Harbour to affect bathing beaches located to the east and west of the harbour mouth. Studies have demonstrated that the harbour does not affect bathing beaches in near proximity.

The extensive upgrades by local industry represent 95 percent of the actions required to restore beneficial uses (Figure 14). The improvements in environmental quality ave been dramatic and in the near future, it is anticipated that Wheatley Harbour will no longer have the attributes of an Area of Concern. This victory is to be celebrated.

Figure 14: Progress on Wheatley Harbour RAP implementation and restoration of beneficial uses as of July 1997



**Not Impaired (AA) = Redesignated based on additional assessment

* RAP delisting targets are determined locally, and may or may not be equivalent to complete restoration of beneficial uses

Niagara River

The Niagara River is the connecting channel between Lake Erie and Lake Ontario. The Area of Concern extends the entire 28 kilometres of the Niagara River and includes the Welland River drainage basin. The rivers in the Area of Concern have multiple uses, including energy generation, recreation/tourism, industry, and drinking water. The heavy concentration of industry located on the United States side remains the largest contributor to use impairments. Non-point sources include urban and rural runoff, combined sewer overflows, and landfills. In Ontario, 16 municipal and industrial point sources discharge contaminants to the Niagara River and its tributaries. However, since less than 1 percent of the flow to the Niagara River originates on the Canadian side of the watershed, substantial actions need to be initiated on the U.S. side of the Area of Concern and in Lake Erie for beneficial uses to be restored in the Niagara River. New York state declined a formal binational approach to develop this RAP.

NIAGARA RIVER USE IMPAIRMENTS	STATUS
Restriction on fish and wildlife consumption	Impaired
Degradation of fish and wildlife populations	Impaired
Bird or animal deformities, reproduction problems	Impaired
Degradation of benthos	Impaired
Restrictions on dredging activities	Impaired
Eutrophication with undesirable algae	Impaired
Restriction on drinking water; taste and odour problems	Impaired
Beach closures	Impaired
Degradation of phytoplankton and zooplankton communities	Under Assessment
Loss of fish and wildlife habitat	Impaired

With the substantive decreases in chemical loadings since the inception of the RAP, consumption advisories for freshwater drum and coho salmon have been removed. The advisories in the Upper Niagara River have declined, but there has been no change in the advisories for Lower Niagara River, a reflection of the more extensive industrial activity in the U.S. side of this reach of the river.

Early suggestions that toxins could be causing deformities in wildlife were based on the occurrence of jaw deformities in deer. Subsequent research concluded that observations were due to overpopulation and inbreeding. The potential for reproductive problems was raised with the detection of DDT metabolite residues in eggshells of herring gulls. The Long Point Bird Observatory, however, has no recorded incidences of deformities and the number of herring gulls in a colony just above the falls has remained. Another positive signal is the increase in raptor populations, and further encouraging signs of the return of the bald eagle. These advances are a clear tribute to the banning of PCBs and the virtual elimination of DDT.

Due to the industrial and agricultural activities in the region, benthos is impaired throughout the watershed. Remedial activities include the full-scale removal of 10,500 cubic metres contaminated sediment in 1995 at the Welland River Reef, the clean-up of coal tar deposits at Chippewa Creek, and the clean-up at Atlas Steel. These are pivotal advancements towards fully restoring beneficial uses, and monitoring will continue to track recovery of benthic communities.

Fish populations and habitat in the Welland River and tributaries are degraded and angling success is poor. A number of fish and wildlife habitat rehabilitation projects are planned, and others are underway. A wetland habitat re-creation project involves cattail replanting to restructure the flows in the Binbrook Reservoir, leading to an increase in spawning areas. The Niagara River Natural Heritage Strategy will further identify priority sites for upland habitat rehabilitation. Of note, Birdlife International has identified the Niagara River as an Important Bird Area for resident birds, and as a stopping ground for the global bird population. Twenty percent of the global population of Bonapart gulls can be found in the Area of Concern.

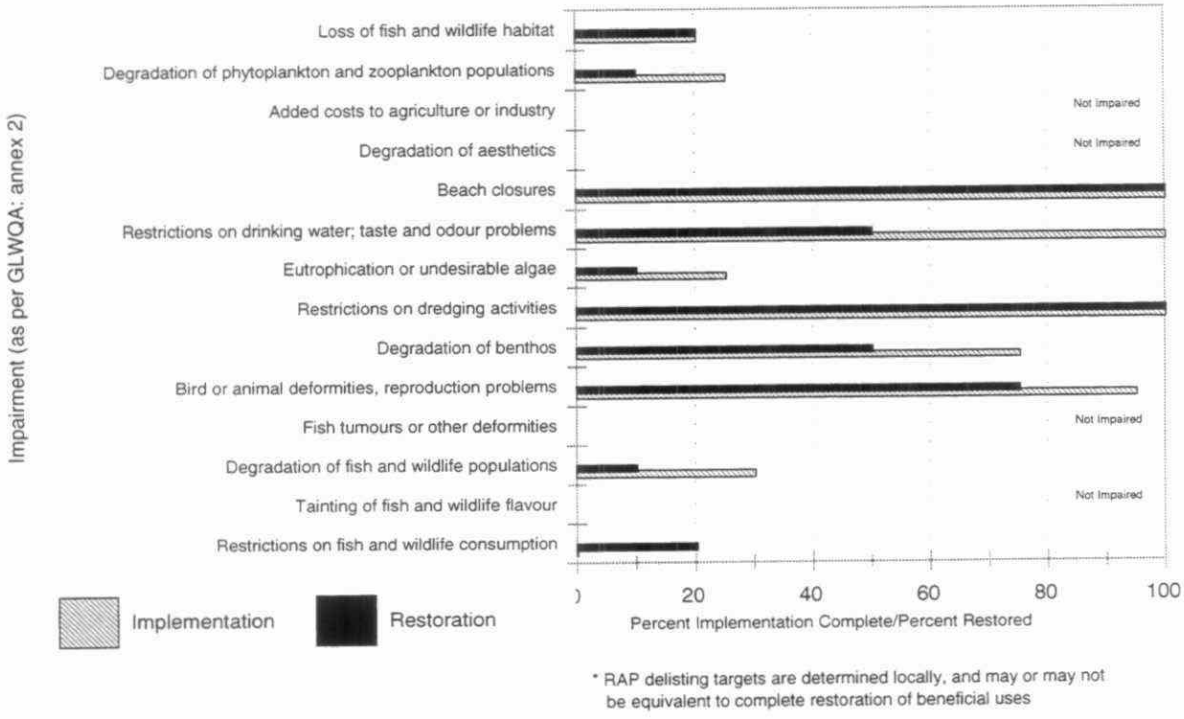
At lest half of the habitat enhancement projects recommended for Frenchman Creek are now complete, including litter pickup, dam removal, and channel improvements. Populations of emerald shiners and white suckers in particular have responded, and are serving as prey for muskellunge, which are now moving to Frenchman Creek from the Niagara River and are spawning. The Frenchman Creek initiative serves as a model of success for the RAP.

Further improvements to biotic communities require that eutrophication be addressed. The Welland Sewage Treatment Plant has been upgraded from primary to tertiary treatment, and a ten-year plan to address combined sewer overflows began in 1996. This year marks the third of a ten-year non-point source reduction program to address manure runoff, milk house wash water, and livestock access to the Welland River and its tributaries. Currently, 10 percent of agricultural practices are no-till. These are incremental successes that have resulted from community involvement. Taste and odour problems have been attributed in part, to increased blue-green algae densities concurrent with Lake Erie zebra mussel activity. In response, the region has installed carbon filtration systems in all municipalities.

In the late 1980s, beaches were closed virtually all of the summer season. Under the former provincial Cleanup Rural Beaches (CURB) Program, the RAP gained control of sources such as inadequate septic systems, combined sewer overflows, and livestock and milk house discharges. In the past three years, not a single beach closure has occurred in the Binbrook Reservoir watershed.

The RAP estimates that progress in mitigating of combined sewer overflows, rural and point source control, contaminated sites clean-up, and habitat rehabilitation, represent 50 percent of the actions necessary to achieve the Canadian RAP delisting targets (Figure 15). Since less than 1% of the flow to the Niagara River originates in Ontario, to be fully restored, considerable

Figure 15: Progress on Niagara River RAP implementation and restoration of beneficial uses as of July 1997



* RAP delisting targets are determined locally, and may or may not be equivalent to complete restoration of beneficial uses

U.S. effort will be required.

Hamilton Harbour

Hamilton Harbour lies at the western edge of Lake Ontario and its 500 square kilometre watershed is drained by three main tributaries. Six municipalities and a population of over half a million reside in the watershed. Canals and infilling of 25 percent of the original bay have eliminated 75 percent of the wetlands, protected inlets, and shallow areas. On the southern shores, a deep water port supports the largest concentration of heavy iron and steel industries in Canada, while the upper reaches of the watershed have a mixture of rural and urban land uses.

HAMILTON HARBOUR USE IMPAIRMENTS	STATUS
Restriction on fish and wildlife consumption	Impaired
Degradation of fish and wildlife populations	Impaired
Fish tumours or other deformities	Impaired
Bird or animal deformities, reproduction problems	Under Assessment
Degradation of benthos	Impaired
Restrictions on dredging activities	Impaired
Eutrophication with undesirable algae	Impaired
Restriction on drinking water; taste and odour problems	Not considered a Use in Area
Beach closures	Restored
Degradation of aesthetics	Impaired
Degradation of phytoplankton and zooplankton communities	Under Assessment
Loss of fish and wildlife habitat	Impaired

Mercury, mirex, PCBs, dioxins, and furans in the system result in fish consumption advisories. There are no local sources of mirex, dioxins, or furans in Hamilton Harbour, which reflect lakewide conditions. The steel manufacturing industry is a likely source for mercury emissions. Reductions in loadings from sewage treatment plants, combined sewer overflows, and storm sewers, have resulted in a decline in PCBs entering the Harbour and should contribute to improvements in fish advisories over the long term.

The benthic community has been historically degraded due to significant discharges of contaminants from local industries. A contaminated sediment removal project has been completed at Windermere Basin and a similar project is anticipated for a PAH-contaminated zone near Randal Reef. Combined sewer overflow abatement initiatives and the implementation of a watershed stewardship program, whereby landowners deter stream bank erosion, will further improve sediment quality. A decline in loadings from industry (Stelco, Dofasco) and sewage treatment plants in the AOC since the mid 1980s will also aid in the enhancement of sediment quality and the rehabilitation of the benthic community. Loadings of metals such as chromium, lead, cyanide, and zinc have decreased by 80 percent since 1990, and Stelco has decreased loadings of ammonia by 70 percent. PAHs and benzo(a)pyrene

concentrations in sediment have declined by 50 percent. All these actions represent step-wise contributions to benthic recovery. Since 1964, benthic biomass in the Harbour has increased between five and tenfold, and the number of species has increased by almost 60 percent. Community composition has shifted away from strictly pollution-tolerant species to include some more pollution-sensitive species. These are indicators of the successes achieved toward the goal of restoring the Hamilton Harbour ecosystem.

External lesions including lip papillomas have declined in brown bullheads, and liver tumours are almost non-detectable. While both are still detected in the white sucker population, similar deformities are found in relatively unpolluted sites, the cause of which has yet to be determined.

More than 60 percent of the total fish biomass in Hamilton Harbour consists of nonnative species such as carp, alewife, and white perch. An impressive degree and diversity of habitat rehabilitation initiatives are completed or in progress. Wetland rehabilitation, marsh plantings, enhancement of fish spawning habitat, and the construction of islands to provide sheltered embayments along Cootes Paradise and various riparian habitat areas are extensive. Marshes in Cootes Paradise and the south and west shores of Hamilton Harbour now support diverse fish and wildlife populations. Preliminary indications are that fish communities in the Harbour itself have not yet responded to rehabilitation initiatives.

Targets pertaining to wildlife are being achieved. The number of nesting pairs of common terns has increased by 24 percent, herring gulls by 38 percent, Caspian terns by 48 percent, and double-crested cormorants by 93 percent.

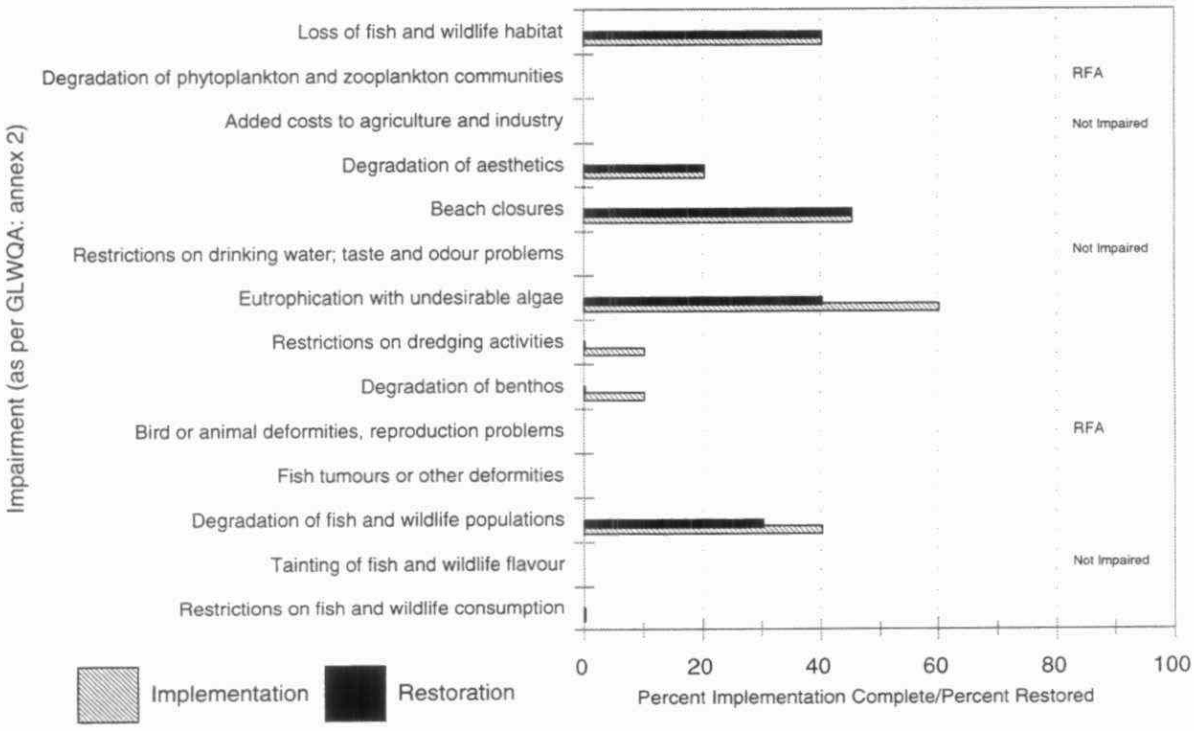
Considerable effort has been directed at reversing eutrophication. An upgrade is underway at the Woodward Avenue Water Pollution Control Plant and the plant's phosphorus removal efficiency has been optimized. Flows have increased by 10 percent, nevertheless, phosphorus loads have decreased by 50 percent. At the Burlington Skyway plant, the upgrade and optimization resulted in a decrease in total suspended solids and biological oxygen demand by 29 and 42 percent, respectively. Flow has increased more than have phosphorus loads (17 and 11 percent respectively). The Dundas plant, a tertiary treatment facility, has decreased phosphorus loads by 33 percent, despite an increase in flow volume. In total, the discharge of

phosphorus from point sources has declined from 1600 kilograms per day in the mid 1970s to less than 10 kilograms per day. Phosphorus concentrations in the harbour have responded by declining from 80 micrograms per litre to approximately 40 micrograms per litre, since the mid 1970s, substantive progress toward the RAPs final target of 17 micrograms per litre. The interim goal of a secchi disc depth of 2 metres has been achieved.

To attenuate non-point source contamination, a project is underway to test techniques for creating a wetland in the Spencer Creek watershed to capture agricultural runoff and remediate non-point source pollution. Combined sewer overflows, and to some extent geese faecal material, also contribute to bacterial contamination. Approximately 45 percent of combined sewer overflows are being captured through the construction of tanks to prevent overflows during heavy rainfall. Swimming generally occurs in the west end of the harbour at Pier 4 Park and Hamilton Bayfront Park, and these beaches are now open for most of the bathing season as a result of RAP implementation.

Overall, 30 percent of actions to be taken to restore beneficial uses in the Hamilton Harbour Area of Concern have been implemented, and beneficial uses are clearly responding (Figure 16).

Figure 16: Progress on Hamilton Harbour RAP implementation and restoration of beneficial uses as of July 1997



Metro Toronto and Region

The Metro Toronto and Region Area of Concern contains six major watersheds that drain into the waterfront; Humber, Don, and Rouge Rivers, Etobicoke, Mimico and Highland Creeks. With more than three million people in an area of about 2000 square kilometres, the greatest challenge is urbanization. Continued growth pressures have resulted in bacterial and nutrient inputs, and heavy metal and organic chemical contamination from sewage treatment plants, combined sewers, and storm sewers. Agricultural non-point sources are problematic in some of the upper watersheds.

METRO TORONTO AND REGION USE IMPAIRMENTS	STATUS
Restriction on fish and wildlife consumption	Impaired
Degradation of fish and wildlife populations	Impaired
Fish tumours or other deformities	Under Assessment
Bird or animal deformities	Under Assessment
Degradation of benthos	Impaired
Restrictions on dredging activities	Impaired
Eutrophication with undesirable algae	Impaired
Beach closures	Impaired
Degradation of aesthetics	Impaired
Degradation of phytoplankton and zooplankton communities	Under Assessment
Loss of fish and wildlife habitat	Impaired

Consumption advisories are present for large size classes of chinook salmon, coho salmon, brown trout, lake trout, rainbow trout, and carp. Mirex originates from upstream sources in the Niagara River. PCBs are present in Toronto's stormwater runoff and in harbour sediment and may contribute to local consumption advisories. Due to improved stormwater management practices, however, contaminant levels are declining in fish from the Don River, and advisories for smaller size classes of some species have been lifted.

Contaminated sediment is present in the Inner Harbour, Humber Bay, and Ashbridges Bay, due to sewage treatment plant effluent, combined sewer overflows, and stormwater runoff. While the frequency of fish tumours and other deformities is reported to be greater for the Inner Harbour than for the rest of the Area of Concern, more than 75 percent of the sediment in the Inner Harbour shows no signs of chronic toxicity to benthos.

Concentrations of metals in Keating Channel have declined over the past two decades. Zinc has decreased substantially, and limited data on cadmium also shows a downward trend in sediment. The progressive recovery is attributed to incremental improvements to infrastructure. The stormwater pond in Markham and the Dunker's flow balancing system in Scarborough, currently under construction, are the most recent examples of innovative stormwater

management. By 1995, lead concentrations were more than 50% lower than those measured in the early 1980s, reflecting the transition to lead-free fuel, the network of highways in sewer shed, and the sensitivity of the harbour to surface runoff.

Habitat rehabilitation programs along the Toronto Waterfront represent efforts to undo decades of historical infilling. Extensive restorative achievements at Colonel Samuel Smith Park have resulted in an active recreational facility that has incorporated a functional spills management structure to treat industrialized runoff while contributing to wildlife diversity. At Humber Bay Park, a wetland at the mouth of the Mimico Creek is planned. At Tommy Thompson Park, initiatives include littoral and riparian habitat enhancement, and 1997 marks the second of a three-year plan to create 30 hectares of wetland habitat. Across the waterfront, existing habitat has been enhanced and new habitat created to attract common terns.

Habitat creation initiatives for coldwater fish, are being considered in the Humber watershed, at Purpleville Creek, Grenadier Pond, and along the Humber River valley and stream corridor. The Metro Rural Clean Water Program for the Upper Humber addresses nutrient and bacterial loadings from septic systems, wastewater discharges, and livestock access, and has rehabilitated more than 1.7 kilometres of riparian habitat while attaining a nutrient load reduction of more than 46 kilograms per year.

In the Rouge River watershed, projects are directed at habitat for coldwater and warm water fisheries such as planting of stream bank vegetation, maintaining wetlands, and the construction of a fishway around the Milne Dam. The Spring Creek habitat rehabilitation project has created 270 metres of new and shaded stream in the watershed. The City of Scarborough has protected part of the lower Rouge by its rezoning as an environmentally significant area. Based on the presence of key indicator species such as coyotes and white-tailed deer, regeneration of the Rouge River watershed has resulted in a highly functional habitat more than 60 percent of the watershed.

The Don watershed program includes wetland creation at the Don Brickwork and Chester Springs, Mud Creek rehabilitation, Ruport's Pond enhancement, and redesigning of two weirs at Pottery Road. More than seven hectares of wetlands, representing 0.14 percent of the watershed, have been created in the past few years, with the target being 0.5 percent. Perhaps

the single greatest achievement in the Don watershed, now more than 80 percent developed, is the significant number of residents that are actively involved in naturalizing and beautifying the Don. The volunteer program currently has 1,000 persons participating. While the challenge to rehabilitate habitat in this megalopolis is great, these activities are a clear signal that cumulative progress is underway and can be successful.

Eutrophication has been evident at the waterfront, Inner Harbour, and Humber Bay. Pockets of attached algae proliferate along hardened shorelines. Phosphorus concentrations are attenuating in the Don Watershed with the removal of sewage treatment plant outfalls from the River. Infrastructure upgrades have improved conditions in the Inner to a mesotrophic state. Humber Bay is still eutrophic, with *Cladophora* blooms limited to the extreme near shore environment. Construction of an interceptor tunnel (Western Beaches Tunnel) to collect combine sewer overflows is anticipated to dramatically reverse eutrophication in this region of the AOC.

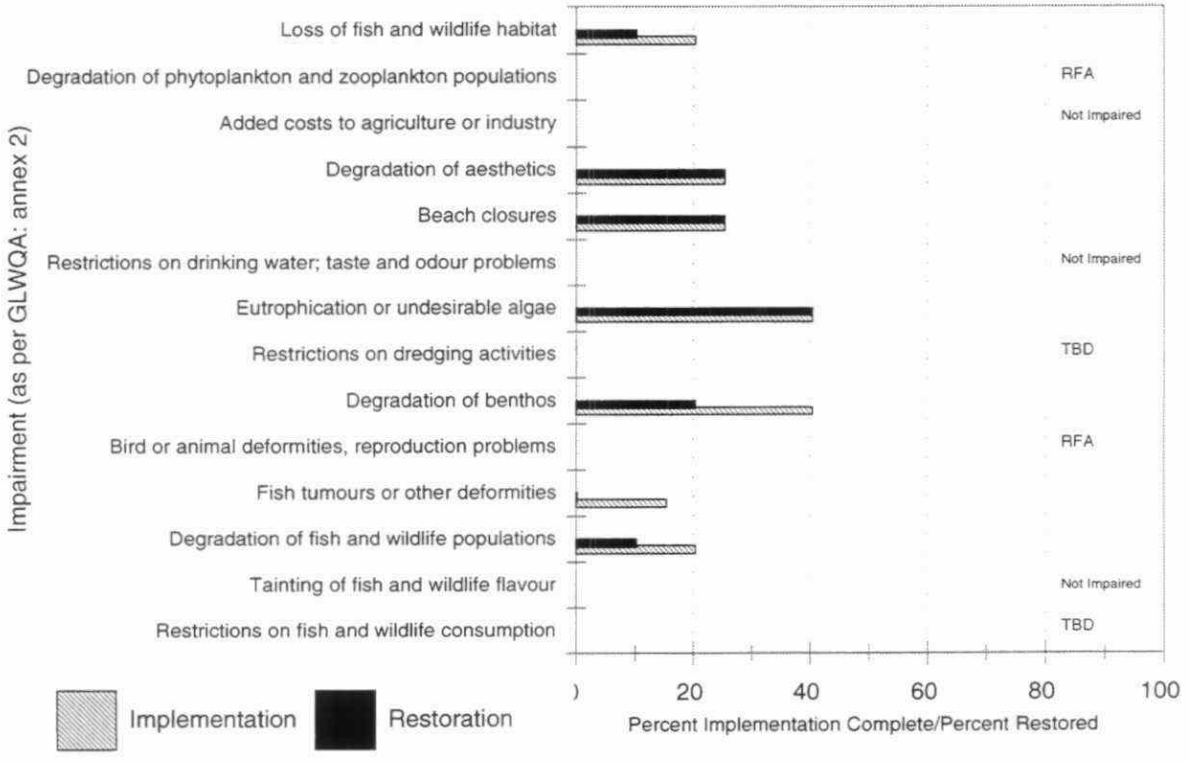
Infrastructure programs are also resulting in progress toward restoring swimming at the five beach areas which are routinely monitored. Beaches in Etobicoke are expected to improve following replacement of the storm sewer system, which is underway. Humber Bay Park will again be open for swimming once construction of the Western Beaches Tunnel is completed. 95,000 cubic metres of combined sewer overflows which are currently discharged from 12 outfalls will be captured. There is current no swimming in the Don watershed, however, infrastructure retrofits and sewer separations mark the first steps of part of a 30-year stormwater management plan to restore that use. The two Eastern Beaches Tanks are complete and are reducing combined sewer overflow volume by 5 percent. Safe swimming conditions now exist in the eastern beaches virtually all summer. Scarborough's Bluffers Park and Rouge Park Beaches are fully open, as are Too Good Pond, Milne Park, and Bruce's Mill in Markham. In addition to costly infrastructure upgrades, many municipalities have rain barrel and downpour disconnection projects for stormwater management and public education.

Along the Waterfront, floating debris and algae have impaired aesthetics. Significant investments in sewage treatment facilities and storm sewers, have earned improvements in aesthetic quality over the past decade. The Inner Harbour is responding to the transition from

industrial to commercial/residential uses, and residents of the upper Rouge River are enjoying the benefits of tree plantings along the tributaries.

Sediment and habitat conditions in the Metro Toronto Region are improving. Outstanding issues that need to be addressed further include combined sewer overflows and sewage treatment plant upgrades. Implementation is 20 percent complete in the Metro Toronto and Region, and has resulted in incremental improvements in beneficial uses (Figure 17). This estimate is an overall synopsis of the six watersheds, and underestimates progress in the Rouge and Highland Creeks, the Waterfront and some subwatersheds of the Don River.

Figure 17: Progress on Metro Toronto and Region RAP implementation and restoration of beneficial uses as of July 1997



RFA = Requires Further Assessment
TBD = To be determined

* RAP delisting targets are determined locally, and may or may not be equivalent to complete restoration of beneficial uses

Port Hope Harbour

Port Hope Harbour is located at the mouth of the Ganaraska River on the north shore of Lake Ontario approximately 100 kilometres east of Toronto. The harbour consists of the west slip, 40 metres wide and 305 metres in length, and the turning basin with dimensions of 195 by 135 metres. Approximately 90,000 cubic kilometres of sediment located in the turning basin and west slip areas of Port Hope Harbour are contaminated with uranium and thorium series radio nuclides, heavy metals, and PCBs. The contamination of the harbour sediment with low level radioactive waste from refining and processing of uranium and radium, has caused a halt to maintenance dredging in this area. Continued sedimentation will in time render the turning basin inoperative as a boat mooring facility.

PORT HOPE HARBOUR USE IMPAIRMENTS	STATUS
Restrictions on dredging activities	Impaired

In order for the harbour to remain operative, the removal of sediment from the turning basin and west slip areas is required. Federal Cabinet approval is necessary prior to proceeding to the next stages of the development of the low-level radioactive waste facility. Any proposed facility must also be licensed by the Atomic Energy Control Board and is subject to the Canadian Environmental Assessment Act. This RAP, therefore, is following a different process than the other Canadian Areas of Concern. Progress is dependent upon the selection and approval of an appropriate facility.

Bay of Quinte

The Bay of Quinte is a z-shaped embayment on the north shore of Lake Ontario. The bay is approximately 100 kilometres long and its drainage area is 17,315 square kilometres. Three cities, six towns, 14 villages and four First Nations are located in the drainage basin of the bay, surrounded mostly by agricultural or forested land. Diffuse agricultural inputs, sewage treatment plants, industrial discharges, urban runoff, and atmospheric deposition are the pollution sources contributing to use impairments.

BAY OF QUINTE USE IMPAIRMENTS	STATUS
Restriction on fish and wildlife consumption	Impaired
Degradation of fish and wildlife populations	Impaired
Fish tumours or other deformities	Under Assessment
Degradation of benthos	Impaired
Restrictions on dredging activities	Impaired
Eutrophication with undesirable algae	Impaired
Restriction on drinking water; taste and odour problems	Impaired
Beach closures	Impaired
Degradation of aesthetics	Impaired
Degradation of phytoplankton and zooplankton communities	Impaired
Loss of fish and wildlife habitat	Impaired

Abatement activities at Strathcona Papers, Domtar Packaging, and Domtar Wood Preservers have resulted in decreased mercury and PCB concentrations in the aquatic environment. As a consequence, fish advisories have declined from seven to three species, clear progress in resting this beneficial use. Fish tumours occur in the AOC at the same frequency observed in fish from relatively unpolluted areas, and are believed to be a Great Lakes basin or lakewide phenomenon, which is not attributable to local sources.

Eutrophication and zebra mussel are believed to be the determinants of the 40 percent reduction in walleye catch between 1990 and 1995. The non-point source control strategy aims in part, to reverse this trend while enhancing habitat. Nine kilometres of riparian/aquatic habitat have been protected. An additional 10 kilometres of shoreline have been restored through the RAP landowner contact program. Riparian habitat restoration and wetland creation are underway, and inventory of wetlands and near shore habitat has been completed. Presently, two-thirds of the upper watershed is fully forested. A 30 percent forest cover is targeted for the lower third, which has more urban features than the upper watershed.

Further actions to enhance wildlife populations include the RAP's "Take a Little Lead Out" which offers anglers nontoxic alternatives to lead sinkers and jigs, and has resulted in the removal of more than 260 kilograms of lead from the system, lowering the potential pathway for ingestion by waterfowl. The construction of artificial nesting platforms to enhance breeding has resulted in an increased presence of osprey and bald eagle nests have been observed. Additional management plans for threatened species, such as lake sturgeon and least bittern, mark considerable progress towards achieving the RAP delisting targets.

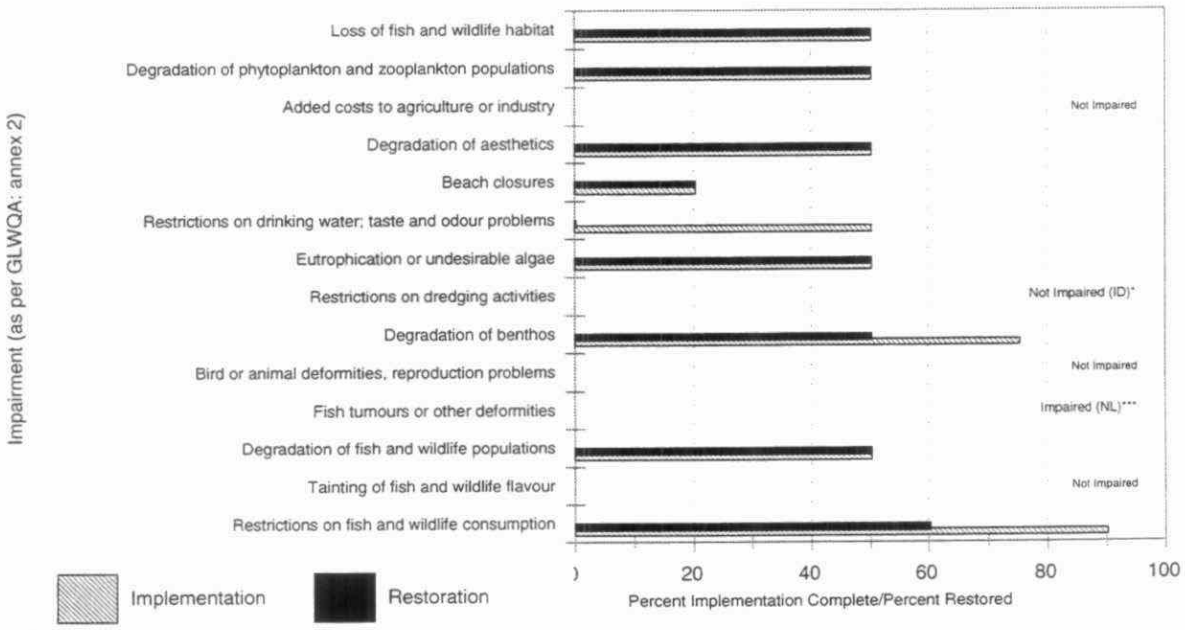
Localized zones of sediment contamination remain. In 1995, mine shafts were closed at an abandoned Deloro mine site, which since 1978 has been an arsenic treatment facility. Abatement programs are being designed and implemented to mitigate the effect of arsenic residues leaching into the Moira River and other sites downstream of the plant. Sediment containing creosote at the wood preserving industry has been cleaned up. Part of ongoing site decommissioning by the federal government includes managing contaminated sediment at the Bakelite Thermoset plant. Each of these actions contributes incrementally to restoring the Bay of Quinte ecosystem. There is no dredging required in the navigational waterways in Bay of Quinte.

Both point and non-point sources contribute to the eutrophication problem in the Bay of Quinte. Seven of the eight point sources directly bordering the bay have been addressed, with two major upgrades, one optimization assessment, one optimization program, and one decommissioning completed. Phosphorus loadings from these point sources have decreased from 50 kilograms per day to less than 25 kilograms per day, with a further reduction by as much as 50 percent anticipated. To control non-point sources, almost 16,000 hectares of farmland have been converted to conservation tillage. The target is 80,000 hectares. The RAP calculated that annual phosphorus load reductions from rural sources of 12,000 kilograms are required to recover from hypereutrophic conditions. The RAP has achieved a substantive loading reduction to date of 6,000 kilograms. Since non-point sources contribute more than half to the eutrophication problem in the Bay of Quinte this milestone is particularly important. In-bay phosphorus concentrations have declined from 80 micrograms per litre to close to the RAP target of 30 micrograms per litre.

At Moira, two beaches are closed due to contamination by gulls and industrial effluent. Possible remedial actions include the disinfection of the beaches, or the diversion of industrial pipes which release combined sewer overflows. Non-point agricultural sources, stormwater inputs, and rural runoff are being addressed and will improve swimming conditions. Similarly, the Environmental Farm Plan program which is educating area farmers about livestock access restrictions and septic improvements have contributed to a reduction in bacteria loadings, in addition to nutrient control.

Progress in implementing the point and non point sources inputs, and in restoring habitat, represent 60 percent of the planned actions needed to restore beneficial uses. Measurable incremental improvements in environmental quality bespeak broad community participation and solid partnerships have been the hallmark of the Bay of Quinte RAP's success (Figure 18).

Figure 18: Progress on Bay of Quinte RAP implementation and restoration of beneficial uses as of July 1997



*Not Impaired (ID) = inappropriately designated 'Impaired'
***Impaired (NL) = not due to local sources

* RAP delisting targets are determined locally, and may or may not be equivalent to complete restoration of beneficial uses

St. Lawrence River

The St. Lawrence River at Cornwall Area of Concern extends from the Moses-Saunders Power Dam at Cornwall to the Beauharnois Power Dam in Quebec. It is a complex jurisdictional area involving Canada, United States, Ontario, Quebec, New York State, and the Mohawks of Akwesasne. Transboundary impacts of PCBs from the U.S. Superfund sites in Massena, New York and mercury from industries in Cornwall, Ontario are the major causes of contamination. New York state declined a formal binational approach to develop this RAP.

St. Lawrence River	Status
Restriction on fish and	Impaired
Tainting of fish and wildlife flavour	Under Assessment
Degradation of fish and wildlife	Impaired
Fish tumours or other deformities	Impaired
Bird or animal deformities, reproduction problems	Under Assessment
Degradation of benthos	Impaired
Restrictions on dredging activities	Impaired
Eutrophication with undesirable algae	Impaired
Restriction on drinking water; taste and odour problems	Impaired
Beach closures	Impaired
Degradation of aesthetics	Impaired
Added costs to agriculture & industry	Impaired
Degradation of phytoplankton and zooplankton communities	Under Assessment
Loss of fish and wildlife habitat	Impaired
Loss of fish and wildlife habitat	Impaired

Fish advisories for nine species are due to mercury and PCBs. A consumption warning is also in place for snapping turtles, based on PCB concentrations in liver tissue. Industrial point sources of contaminants have virtually been controlled in Ontario. The major point source of

mercury, Cortaulds, closed in 1989. ICI discontinued operation of its chlor-alkali mercury cell room in 1994. Domtar stopped using mercurial slimicides and installed a secondary treatment system at its pulp and paper mill in 1995.. A Cornwall sediment management plan is being proposed to address the in-place contaminated sediment, however, a period of natural recovery will be necessary to lift the current consumption advisories, and improve benthic community composition. The decline in mercury loadings are an important element to progress with the restoration of beneficial uses. PCBs, however, continue to be a problem predominantly from U.S. sources. Since contaminants exceed the provincial guidelines, dredged materials must be disposed of in confined disposal facilities.

The cause of the high incidence of liver tumours in older walleye is unclear and could either be typical of aging walleye or the result of an anthropogenic stress. White sucker liver tumour rates have been found to be higher than at control sites, and limb deformities found on mudpuppies in the vicinity of Massena, New York are believed to be a function of contaminants. Domtar is planning to undertake a tainting study to confirm whether a reduction in phenols discharged through the installation of secondary treatment has improved fish flavour.

Fish populations have been affected by the St. Lawrence Seaway and dam construction, in addition to extensive shoreline hardening. Along the Cornwall waterfront, fish numbers have increased in response to the construction of artificial reefs and islands. Tributary and wetland restoration and shoreline stabilization to prevent erosion are also underway.

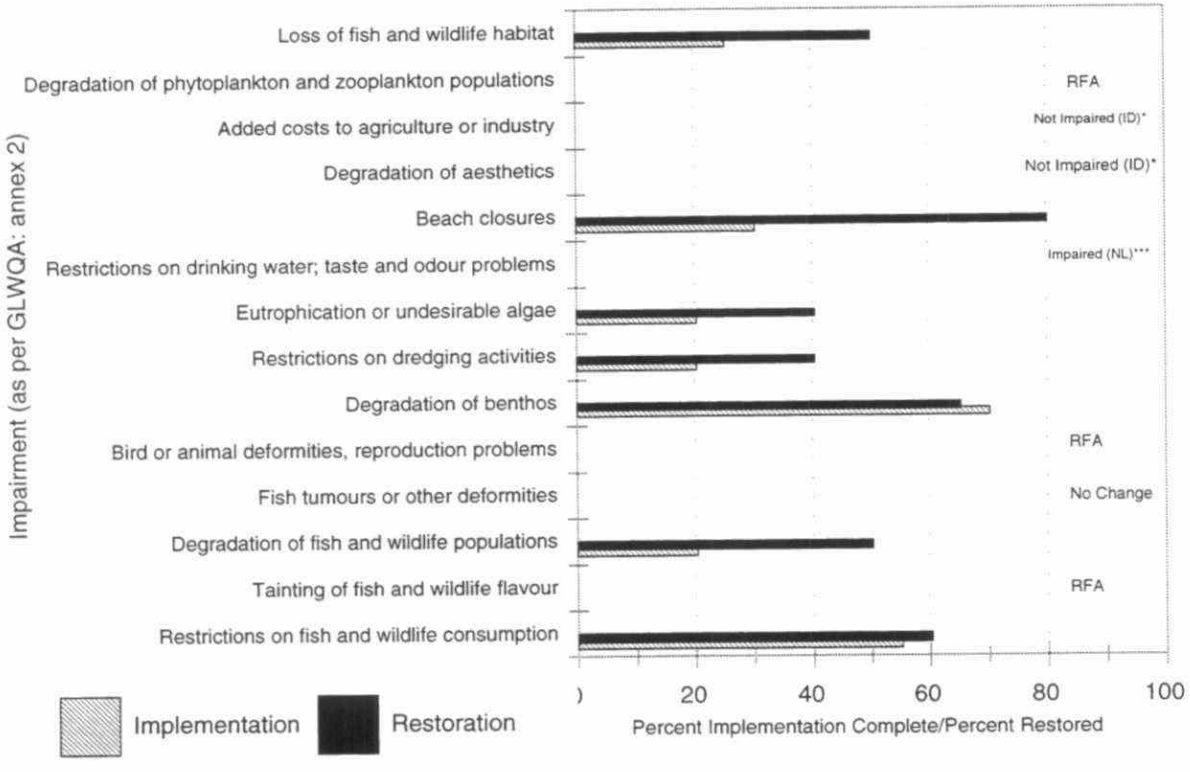
Although the St. Lawrence River itself is not eutrophic, its tributaries are. Non-point source projects are underway and combined sewer overflow work is planned. Reductions in loadings to the river are already measurable. Taste and odour problems, though, are due to elevated algal densities upstream of the Area of Concern. The City of Cornwall is planning to install carbon filters in its water intake system by the fall of 1997.

Water quality in the open waters of the river channel is suitable for swimming, and water contact sports are increasing along the waterfront. Near shore incidences of elevated levels of faecal coliform bacteria are the result of septic systems, combined sewer overflows, and sewage treatment plants. Upgrades to the sewer systems and sewage treatment plants since 1988 have minimized combined sewer overflows and represent incremental progress in RAP

implementation. A pollution control planning study to address ongoing sewage and stormwater treatment needs began in 1995. Rural shoreline stabilization and cattle fencing will also be undertaken to further abate bacterial contamination.

Based substantive industrial abatement and progress in habitat restoration, 40 percent of the planned actions to restore beneficial uses have been implemented. Restoration of beneficial uses is in progress(Figure 19).

Figure 19: Progress on St. Lawrence River RAP implementation and restoration of beneficial uses as of July 1997



*Not Impaired (ID) = Inappropriately designated 'Impaired'
***Impaired (NL) = not due to local sources
RFA = Requires Further Assessment

* RAP delisting targets are determined locally, and may or may not be equivalent to complete restoration of beneficial uses

OBSERVATIONS AND RECOMMENDATIONS

It is the sequential and concurrent actions achieved through the sharing of a common vision and drive that are the genuine, powerful and tangible victories of the RAP program.

It is abundantly apparent that progress towards achieving RAP restoration targets is proceeding at the Canadian Areas of Concern in a step-wise incremental fashion. While some consider delisting to be the criterion of success, we contend that it is the sequential and concurrent actions achieved through the sharing of a common vision and drive that are the genuine, powerful and tangible victories. In the Canadian AOCs, the gradual, and in some case magnificent improvements in environmental quality and beneficial uses are the hallmark of the RAP program. The return of the bald eagle, order of magnitude drops in contaminant loadings, and improved swimming opportunities are dramatic indicators of the capacity of RAP participants throughout the basin.

To understand the future challenges, it is instructive to evaluate the rate at which actions to restore different beneficial uses are being implemented, ten years after the inclusion of RAPs in Annex 2 of the Great Lakes Water Quality Agreement. Strategies that address the impairments related to micro pollutants (metals, PCBs, etc.) and habitat tend to be well underway. While active clean-up of contaminated sediment is a formidable hurdle (Hartig et al. 1998), specific examples of substantive headway are the sizable loading reductions by industry, and the banning of production of PCBs and other chemicals by government. On the other hand, conventional pollutants, such as nutrients and bacteria, remain problematic in many AOCs. This runs counter to some public and political perceptions that conventional pollutants are a resolved issue, and that toxic chemicals are the single challenge facing the Great Lakes ecosystem.

A particularly troublesome finding is that with the exception of severely contaminated systems, the causative agents for tumors and other deformities, particularly in fish, is for the most part unknown (Abdullah and Krantzberg 1998). Little research is being conducted or funded by the agencies to resolve this unknown, which frustrates efforts to restore this beneficial use.

In understanding why actions directed at population health are more advanced than those which require bacteria and nutrients control, the RAP process itself provides some answers. RAPs have made substantial progress in areas that rely on cooperation and volunteerism. Public involvement in RAPs has been a major breakthrough for ecosystem management and recovery (Hartig and Zarull 1992). Success builds upon accomplishing tangible tasks, and often these are most visible through projects such as habitat rehabilitation (Figure 3A). This is a clear illustration of how a step-wise approach achieves incremental gains in ecological integrity.

With governments focusing on reducing loadings of chemicals from industrial sources, extensive abatement activities have advanced point source control, resulting in declining levels of contamination in water, sediment and biota. This is reflected in the decline of fish advisories throughout the AOCs and reported by the Ontario Government (MOEE 1997).

Conversely, the diffuse nature of non point source inputs and combined sewer overflows, continues to require considerable financing. Without exception, funding is the major concern of agencies and the public involved in implementing RAP recommendations (MacKenzie 1996). The availability of adequate resources to address infrastructure problems is a common concern across many of the AOCs. The current climate of provincial and federal resource restraints means that limited resources are available to implement storm and wastewater controls at a rate anticipated when RAPs began. Nevertheless, noteworthy accomplishments include new, cost-effective technologies that are being effective at controlling nutrients and bacterial loadings (Cleanup Fund 1997).

This has been the first attempt to quantify environmental change across the Canadian AOCs. It is intended in large part to give credit to thousands of individuals for their accomplishments. A record of success should be part of the RAP process to maintain the momentum. For many Areas of Concern, the long-term strategic planning necessary to tackle complex problems such as infrastructure and sediment remediation, builds on the record of success. It also provides a view to where obstacles to progress lay.

The ability to demonstrate progress sustains public and political confidence and support. We recommend a broader accounting of the achievements attributable to RAPs. We urge the

public, the agencies and the IJC continue to press for such accounting. By recognizing and documenting the step-wise improvements in the Areas of Concern, we will be better able to maintain and broaden partnerships and momentum for Great Lakes rehabilitation and protection for the long-term.

The ability to demonstrate progress sustains public and political confidence and support.

A more critical analysis of methods to overcome obstacles to Great Lakes clean-up and protection is also needed. It is important to provide an opportunity to motivate all partners to overcome the challenges that remain to reach the goals and targets for delisting. The ability to demonstrate progress sustains public and political confidence and support (IJC 1989). Annex 2 of the Great Lakes Water Quality Agreement states:

> The Parties shall cooperate with State and Provincial governments to classify Ares of Concern by their state of restoration progressing from the definition of the problems and causes, through the selection of remedial measures, to the implementation of remedial programs, the monitoring of recovery, and, when identified beneficial uses are no longer impaired and the area restored, the removal of its designation as an Area of Concern.

While the parties have been reporting on the first two steps (Stage 1 and 2 Reports) and the final step (Stage 3 Report concurrent with delisting), other incremental steps between plan development and delisting have to date not been accounted for. We recommend the public, the agencies and the IJC continue to press for such accounting, as illustrated by he analysis we have presented.

Literature Cited

Abadallah, M. and G. Krantzberg. 1998. The causative agents of tumour in fish. Report to the COA RAP Steering Committee. In prep.

COA RAP Steering Committee. 1997. The Remedial Action Plan Update. Available from Ontario Ministry of Environment, Great Lakes Programs, 40 St. Clair Ave. W., Toronto, ON. , and at www.cciw.ca/glimr/raps/intro.html

Canada-Ontario Agreement respecting the Great Lakes Basin Ecosystem. 1994

Cleanup Fund. 1997. Great Lakes 2000 Cleanup Fund Project Summaries Report. Environment Canada, Downsview, Ontario.

Environment Canada and US Environmental Protection Agency 1994 Progress in Great Lakes Remedial Action Plans: Implementing the Ecosystem Approach in Great Lakes Areas of concern. Toronto, Ontario and Chicago, Illinois, 210 pp.

Hartig, J. and M. Zarull. 1992. Under RAPs, Towards grassroots ecological democracy in the Great Lakes Basin. Univ. Michigan Press. 289 pp.

International Joint Commission. 1988. Revised Great Lakes Water Quality Agreement of 1978, as amended by protocol signed in Ottawa, Ontario, November 18, 1987. Consolidated by the International Joint Commission January 1988.

International Joint Commission. 1989. Report on Great Lakes Water Quality. Great Lakes Water Quality board, Windsor, Ontario, Canada.

MacKenzie, S.H. Integrated Resource Planning and Management. Island Press. 243pp.

Krantzberg, G., H. Ali and J. Barnes. 1997. Status report on incremental progress in restoring beneficial uses at the Canadian Areas of Concern, a site specific analysis. Ontario Ministry of Environment, Toronto, ON.

MOEE. 1997. Guide to eating Ontario Sport Fish. Ontario Ministry of Environment and Energy, and Ontario Ministry of Natural Resources. PIBS 590B07. 173 pp.

Rocchini, R. and L.G. Swain. 1995. The British Columbia Water Quality Index. Water Quality Branch, Environmental Protection Department, British Columbia Ministry of Environment, Lands and Parks. November 1995.

Smith, D.G., 1990 A Better Water Quality Indexing System for Rivers and Streams. Wat. Res.24(10), 1237-1244. 1990.

Water Quality Board. 1991. Review and Evaluation of the Great Lakes Remedial action Plan Program. IJC, Windsor, Ontario Canada 47 pp.

Water Quality Board 1996. Position Statement on the Future of Great Lakes Remedial Action Plans. IJC, Windsor, Ontario Canada 16 pp.